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Effects of the FLASHJET Paint Removal Process on the Fatigue Properties of Al 7075-T6 and Al 2024-T3

by Victor K. Champagne, Scott M. Grendahl, and Jim Campbell

ARL-TR-3618 **September 2005**

NOTICES

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14. ABSTRACT The purpose of this study was to determine if the FLASHJET process affects the fatigue properties of two aluminum alloys that are commonly used as skin substrates in Army rotorcraft: (1) Al 2024-T3 and (2) Al 7075-T6. The two aluminum alloys were tested in high-cycle fatigue using thin fatigue coupons that were machined prior to painting and paint removal by the FLASHJET process. The high-cycle fatigue properties of these alloys were not degraded by the FLASHJET paint removal technique. This was true whether the specimens were depainted once to saturation or with five painting-depainting cycles simulating typical lifetime conditions. This finding concurs with other studies using similar testing parameters. Through a statistical analysis, the FLASHJET-processed specimens showed a statistically significant improvement in fatigue lifetimes under several testing conditions.					
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1. Introduction

FLASHJET[*] (*1–3*) is a paint-removal system that uses the energy from a xenon flash lamp and subliming dry ice particles to strip paints and primers in a fast, environmentally friendly, and cost-effective manner. It was developed by McDonnell Douglas in 1991, when it combined two processes that were being investigated for depainting operations. In 1986, the Sacramento Air Logistics Center (SM-ALC) used the light energy of a high-energy pulsed xenon lamp to remove paints, but it was found that there were undesirable increases in substrate temperature and difficulty in containing the resultant residue. Blasting a painted surface with dry ice pellets was investigated by the Warner-Robins Air Logistics Center (WR-ALC) in 1990, but surface damage resulted, especially for composite materials and thin metallic structures. FLASHJET was originally intended for depainting composites, but it has now found many applications for metallic structures, including fuselages. Currently, FLASHJET is fully qualified by Naval Air Command for use in metallic fixed-wing aircraft, and a system has been installed at the Naval Air Station, Kingsville, TX, for paint stripping of T-45A aircraft, while Boeing uses FLASHJET on AH-64A Apache helicopter fuselages at their Mesa, AZ, paint stripping facility.

In the FLASHJET process (*4*, *5*), the xenon lamp (typically 12 in) is electrically energized and emits a flash of light that is absorbed by the coating. The photon energy is sufficient to cause a thin layer of the paint to vaporize (ablate). Typically, the pulse intensity is 15–23 J/cm^2 with a frequency of 4–6 Hz. Low-pressure dry ice particles are applied simultaneously to cool the substrate and to sweep away residual ash. The only solid waste is ash, and it is suctioned away and captured by a disposable high efficiency particulate air (HEPA) filter, while organic vapors are remediated by passing the gas through activated charcoal. There is no cleaning pre-treatment step required and subsequently, no pre-painting treatment is necessary. The only areas that need to be masked prior to treatment are windows made of glass or plexiglass. Since optimal distance between the lamp and substrate is imperative, the lamp/applicator is attached to a robotic device that is fully computer controlled. The FLASHJET system can generally reach about 85% of an aircraft's surface, with the remainder depainted by traditional methods.

A significant advantage of FLASHJET is the result of color and proximity sensors that control the pulse rate, travel speed, distance, and power to the xenon lamp. By controlling these parameters, the system can differentiate between a topcoat and a primer. It is possible to skim off less than 0.001 in of topcoat with this method. Therefore, unlike most other paint removal techniques, FLASHJET can remove one painted layer, while leaving other layers intact. Also, it has been found not to degrade chemical conversion coatings or damage aerodynamic sealers and fillers.

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[*] FLASHJET is a registered trademark of Flash Tech, Inc.

The FLASHJET process greatly reduces the hazardous waste associated with standard paint removal procedures, and limits the exposure of toxic compounds to workers. In 1994, a U.S. Army Department of Defense (DOD) study showed that 20%, or 2,500,000 gallons, of DOD-generated hazardous waste was produced in paint removal operations. DOD was mandated by Executive Order 12856 in 1993 to reduce off-site waste treatment or disposal by 50%, which furthered increased interest in alternative paint removal techniques. Boeing and other operators have found a 90% reduction in waste generation compared to standard paint-stripping methods. Since FLASHJET is a fully automated process, operators monitor the process remotely and they are not exposed to the ash or gases formed during coating ablation. However, workers must wear protective eyewear to protect against harmful UV radiation produced by the xenon lamp.

FLASHJET has been shown to be an economical process (*6*), with a typical cost of paint removal of \$4.00/ft^2, compared to ~\$34.00 for traditional chemicals, such as methylene chloride, and \$15.00 for plastic media blasting (PMB). Boeing has stripped the paint from over forty AH-64A Apache helicopter fuselages at their Mesa depainting facility with an approximate life cycle cost of \$3.75/ft^2. A WR-ALC model used to determine estimated life cycle cost per square foot has found similar cost savings for a variety of aircraft from all the DOD services.

The purpose of this study was to determine if the FLASHJET process affects the fatigue properties of two aluminum alloys that are commonly used as skin substrates in Army rotorcraft: (1) Al 2024-T3 and (2) Al 7075-T6.

2. Experimental Procedures

2.1 Materials

Two clad aluminum alloys (Al 2024-T3 and Al 7075-T6) were used to determine high-cycle fatigue behavior after paint removal by the FLASHJET process. Intercontinental Metals Export, Inc., Kennesaw, GA, supplied the alloys in a 4- × 12-ft sheet with a thickness of 0.025 in. The average clad thickness was 0.025 in per side.

2.2 Fatigue Specimens

Fatigue tests were conducted in a center hole configuration (figure 1a) and a crack growth configuration (figure 1b). The dimensions and number of specimens for each test are listed in table 1. All specimens were fabricated to the specified dimensions by Metals Samples Co. of Munford, AL, from the supplied sheet. Specimens were sectioned parallel to the rolling direction.

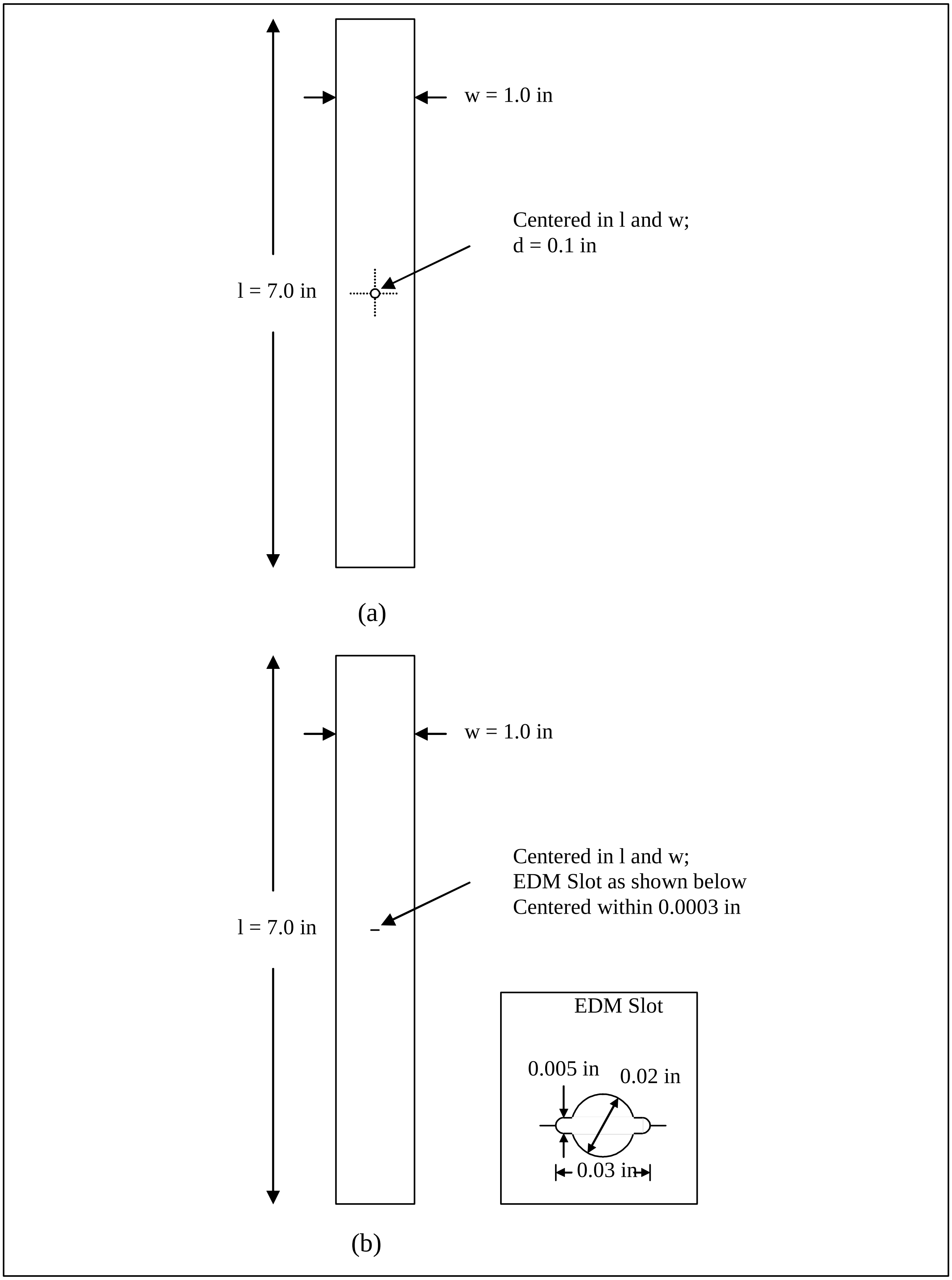

Figure 1. Schematic and dimensions for (a) the center specimens and (b) the center crack-initiated specimens.

Table 1. Type and dimension of Al 2024-T3 and Al 7075-T6 fatigue specimens.

	Center Hole Specimens	**Center Crack Specimens**
Number of specimens	36 Al 2024-T3 36 Al 7075-T6	36 Al 2024-T3 36 Al 7075-T6
Dimensions	Rectangular 7 × 1 × 0.025 in	Rectangular 7 × 1 × 0.025 in
Fatigue hole/crack configuration	0.1 in-diameter hole	EDM slot 0.03 in long × 0.005 in wide; centered within 0.0003 in. At each end, a ~0.02 in long pre-crack for a total crack length of 0.05–0.07 in.

2.3 Pre-cracking of Center Crack Specimen

Prior to painting and paint removal by FLASHJET, the center crack specimens were pre-cracked. As with all mechanical testing, pre-cracking of the specimens was conducted by Westmoreland Mechanical Testing and Research, Inc., Youngstown, PA. It was conducted in pulsation tension with a sinusoidal loading profile and a frequency of 20 Hz. The minimum load applied was 10% of the maximum load, or R = 0.1. Total crack lengths for each specimen, as well as the number of cycles to form these cracks, are listed in appendix A for Al 7075-T6 and Al 2024-T3. For most specimens, 60,000–80,000 cycles were required at the applied stress to produce the desired total crack length of 0.05–0.07 in.

2.4 Specimen Cleaning and Painting

Specimen cleaning and painting was performed at the U.S. Army Research Laboratory (ARL), Aberdeen, MD. Specimens were degreased using trichloroethylene (O-T-634C Type II, ASTM D-3698), which was then followed by an alkaline clean (P-C-436)-(MDA-E P.S. 12030) and, subsequently, by a pickle (MDA-E P.S. 12050.1). Within 4 hours of cleaning, a conversion coat pre-treatment was performed with MIL-C-5541. An epoxy primer (MIL-PRF-23377) was then applied to a dry thickness of 1.0–1.5 mil, which was followed by a polyurethane coating (MIL-PRF-85285, Color Chip 17925 White) to a dry film thickness of 2.0–2.5 mil. After painting, the specimens were air dried for 1 week followed by a bake at 150 °F for 1 week. The same procedures were followed for specimens that were returned for re-painting, with the exception that the topcoat was changed from MIL-PRF-85285 to MIL-C-46168D Type IV, Color Chip 34031 Aircraft Green. This modification was suggested by Boeing and approved by AMCOM, since the proposed topcoat best represented the actual color of fielded systems.

2.5 FLASHJET Paint Removal

The fatigue specimens were divided into three groups for each aluminum alloy:

A. Control Group (conversion coated, not painted, not stripped).

B. FLASHJET to saturate group (number of passes to substrate plus three additional passes).

C. FLASHJET to substrate and five-cycle group (number of passes to substrate, repeated for a total of five painting-depainting cycles). For group C, the repainting procedure (for each of the five cycles) was identical to the steps in section 2.4. The FLASHJET paint removal was performed at Boeing-St. Louis.

2.6 Fatigue Test Procedures

Westmoreland Mechanical Testing and Research, Inc., Youngstown, PA, performed the fatigue testing in this study. Fatigue tests were conducted using the basic guidelines of ASTM-E-466 and tested until fracture. Pulsation tension tests were conducted with a sinusoidal loading profile and a frequency of 20 Hz. The minimum load applied was 10% of the maximum load, or R = 0.1. Two loads were chosen such that they gave cycles-to-failure of ~100,000 cycles and 1,000,000 cycles. Tests that reached 3,000,000 cycles were terminated and considered “runouts.” Crack growth measurements were made with one specimen from each process and from each alloy, for a total of six specimens. At incremental increases in the number of cycles, the loading cycle was paused and the crack length measured. As with the other pre-cracking and S-N tests, these were conducted in pulsating tension at 20 Hz and R = 0.1. For the Al 7075-T6 alloy, the maximum stress applied was 480 psi, while it was 350 psi for Al 2024-T3.

3. Results

3.1 FLASHJET Coating Removal

For processes B and C, the FLASHJET process parameters utilized are described in table 2, as well as nominal and average values reported in the literature (*4*). Typically, the total coating thickness near the crack or hole was ~5–6 mil. It took many passes to remove the paint from the fatigue specimen coupons, and sometimes 15 passes or more were required to remove the paint from a specimen and to give it three saturation passes. Appendix B shows the voltages, coating thickness, and the number of passes for all of the specimens in the process B group. For a few specimens, the temperature was measured on the back of specimens using temperature-sensitive adhesive strips. The results yielded T = 200 to 250 °F. Similar data was obtained for the first cycle in the C group specimens. The greater number of passes needed for coating removal for the Al 2024-T3 specimens was due to the initial coating thickness being ~1 mil thicker compared to the Al 7075-T6 specimens, and it was not the result of any inherent differences between the two materials. For the process C group specimens with the first painting-depainting cycle, the Al 7075-T6 specimens required more passes than the Al 2024-T3 to remove paint to the substrate.

Table 2. Current and literature values for the FLASHJET process parameters.

	Current Values	Typical Range	Nominal Values
Lamp voltage	2000–2300 V	1000–2300 V	2100 V, 1600 V minimum
Stand-off distance	2.2 in	1–5 in	2.19 in
Flash frequency	3 Hz	0.5–8 Hz	4 Hz
Strip head velocity	0.75 in s^{-1}	0.5–5 in s^{-1}	1 in s^{-1}
Blast pressure	160 psig	150 psig	150 psig
Pellet blast angle	—	21–29^o	21^o
Pellet flow rate	—	—	700 lb-s^{-1}
Effluent capture flow rate	—	—	> 1800 cfm

3.2 Fatigue Behavior

The fatigue data for the Al 7075-T6 and Al 2024-T3 in the center hole and center crack configurations are listed in appendices C and D. Figures 2–5 plot the S-N data for the Al 7075-T6 center hole test, Al 7075-6 center crack test, Al 2024-T3 center hole test and Al 2024-T3 center crack test for processes A, B, and C, respectively. Similar trends were found for all four testing conditions in that there was little difference in fatigue lifetimes when comparing the three processing conditions. In fact, the overall trend was that the specimens that were unpainted and not given the FLASHJET treatment (process A) had lower fatigue lifetimes than those treated with either process B or process C. In figure 2, seven of eight process A specimens had lifetimes between 200,000 and 600,000 cycles at 10 ksi, while seven of eight process B and process C specimens had fatigue lifetimes greater than one million cycles at the same stress level. Crack growth data for the six specimens tested is listed in appendix C (Al 2024-T3) and appendix D (Al 7075-T6). No differences in the da/dN vs. ΔK were found for either Al 7075-T6 (figure 6) or Al 2024-T3 (figure 7), with the data overlapping for each process.

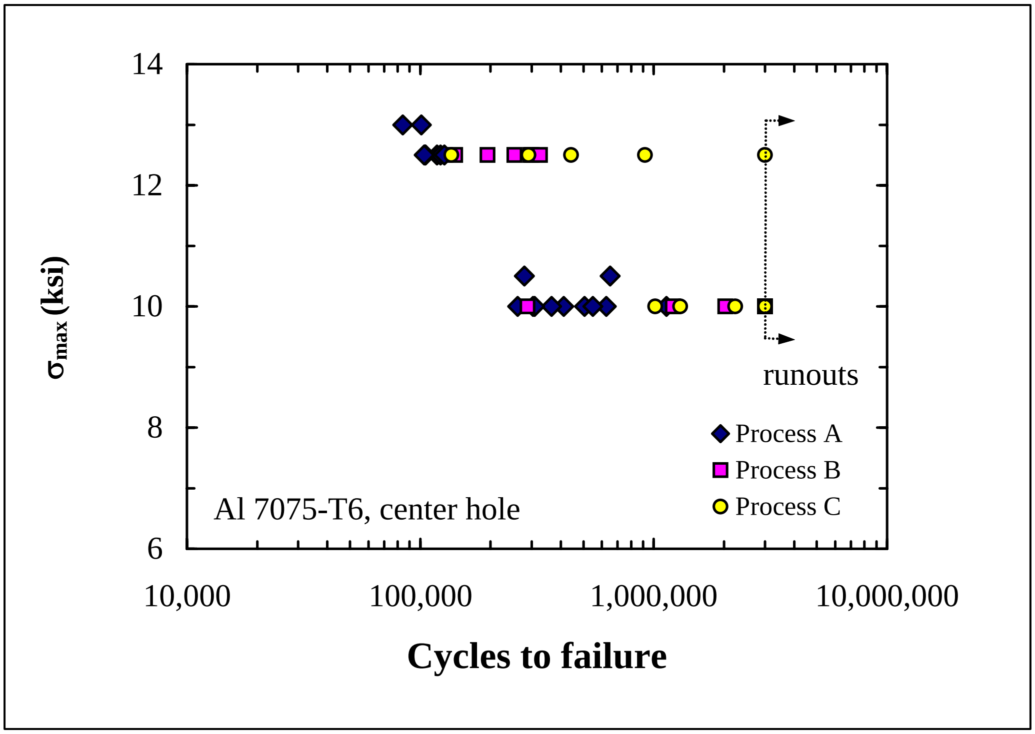

Figure 2. S-N data for Al 7075-T6 tested in the center hole configuration for processes A - baseline, B - FLASHJET to saturate, and C - FLASHJET to substrate/five cycles.

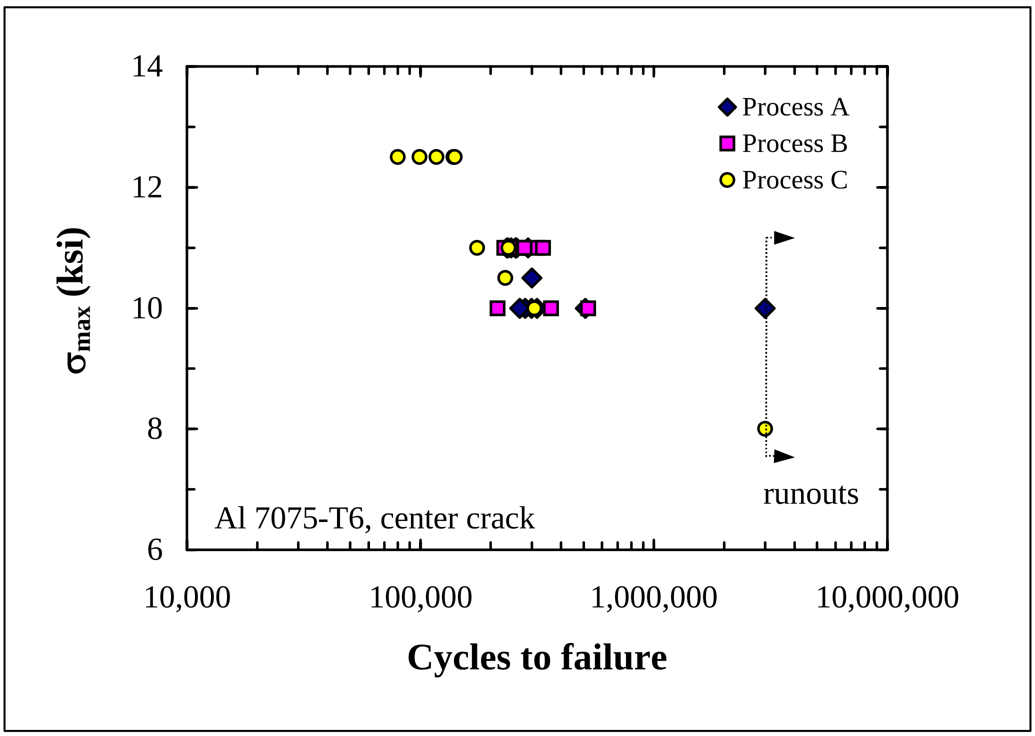

Figure 3. S-N data for Al 7075-T6 tested in the center crack configuration for processes A - baseline, B - FLASHJET to saturate, and C - FLASHJET to substrate/five cycles.

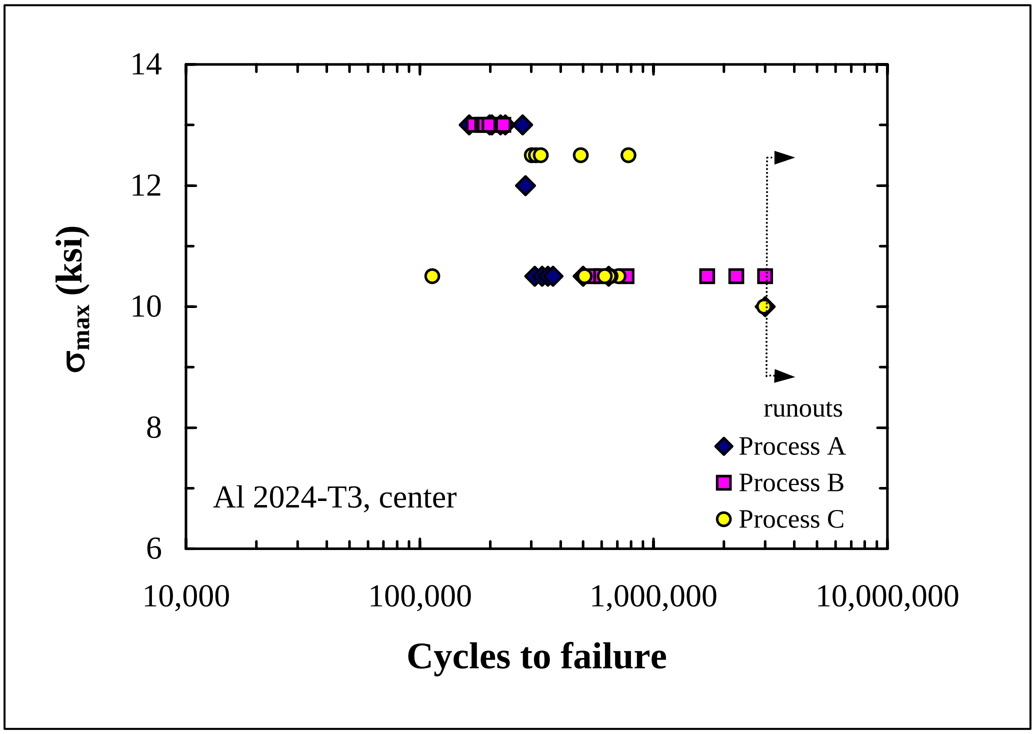

Figure 4. S-N data for Al 2024-T3 tested in the center hole configuration for processes A - baseline, B - FLASHJET to saturate, and C - FLASHJET substrate/five cycles.

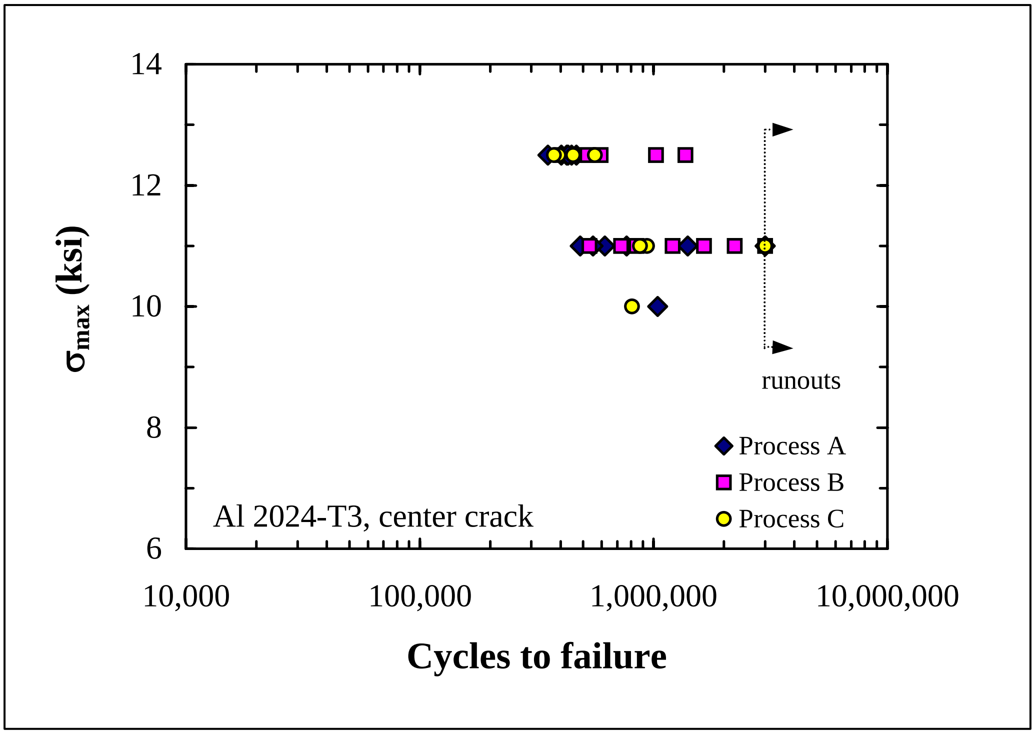

Figure 5. S-N data for Al 2024-T3 tested in the center hole configuration for processes A - baseline, B - FLASHJET to saturate, and C - FLASHJET to substrate/five cycles.

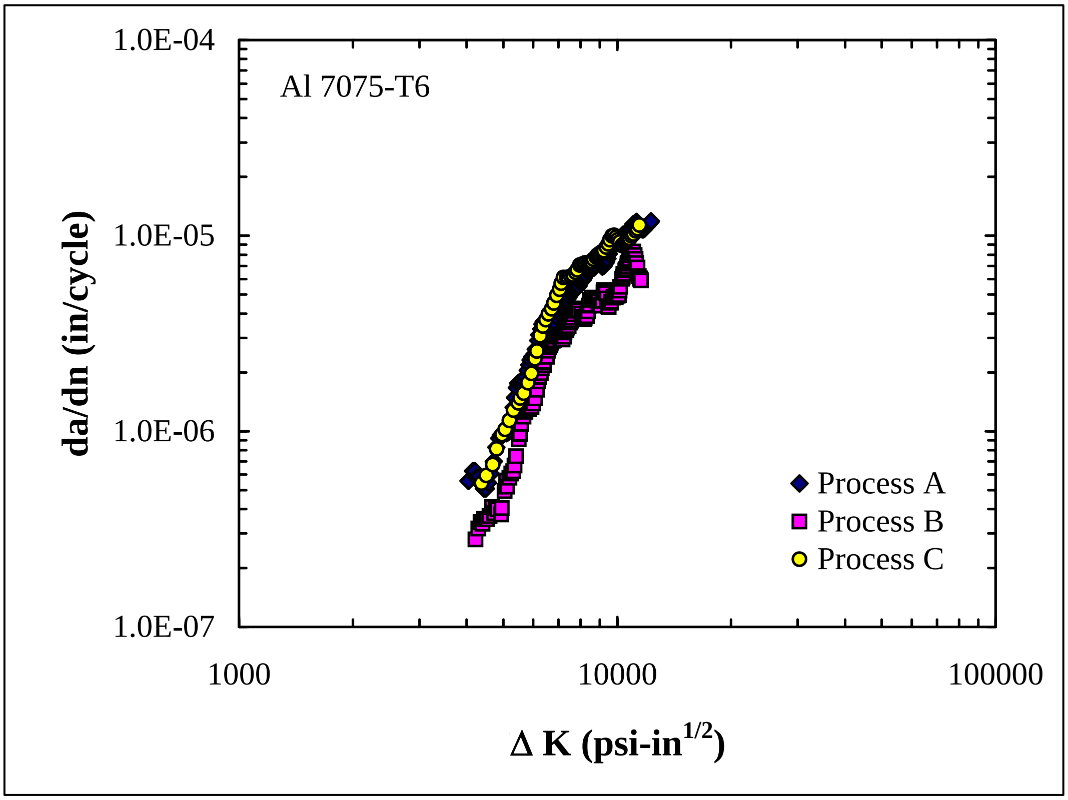

Figure 6. Crack growth data for Al 7075-T6 center crack specimens for processes A - baseline, B - FLASHJET to saturate, and C - FLASHJET to substrate/five cycles.

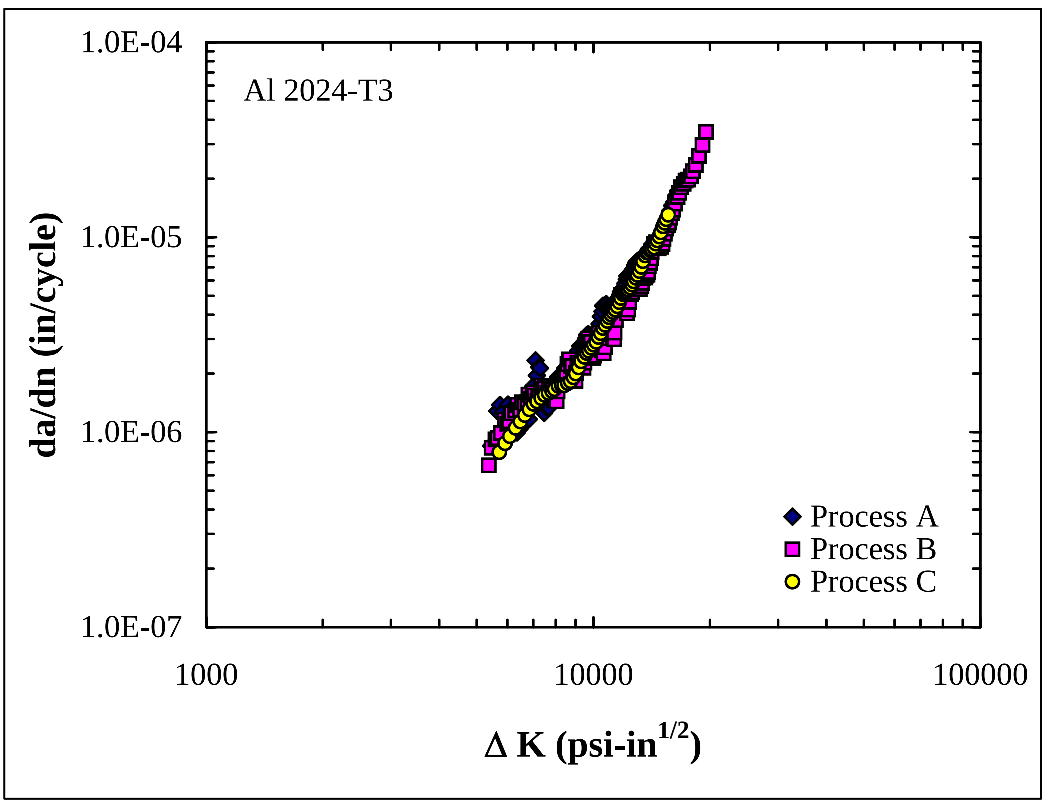

Figure 7. Crack growth data for Al 2024-T3 center crack specimens for processes A - baseline, B - FLASHJET to saturate and C - FLASHJET to substrate/five cycles.

4. Discussion

4.1 Analysis of Fatigue Data

Results in the present study indicate that there was no degradation in fatigue properties of these alloys due to the FLASHJET process. Other studies show similar results, including Kozol et al. (*7*) at the Naval Air Warfare Center in Patuxent River, MD, and Breihan and Reilly (*8*) at the McDonnell-Douglas Corp, now Boeing-St. Louis. However, there were differences in the test methods, including the type of tests and whether the fatigue coupons were machined before or after painting and FLASHJET paint removal.

As with the other two studies, a statistical analysis was performed on the S-N data to better understand trends in fatigue lifetimes. A student's T function, which determines if there is a statistically significant difference in the average mean of sample sets with differing number of tests, was used at a 95% confidence level. The 95% confidence is bounded by:

$$\mu - T(\mu, n\text{-}1) \cdot s/(n\text{-}1)^{1/2} \text{ and } \mu + T(\mu, n\text{-}1) \cdot s/(n\text{-}1)^{1/2}, \tag{1}$$

where μ is the mean in the log of the number of cycles, T (μ, n-1) is the student's T function, n is the number of samples in the set, and s is the standard deviation in the log of the number of cycles. The baseline (process A) was compared to processes B and C for the same alloy/testing configuration and stress level. Appendix E (Al 2024-T3 and Al 7075-T6) shows the results from the comparisons made and table 3 is a summary of this statistical analysis. Comparisons were made for only those sets with at least three specimens. There were a different number of comparisons made for each, since the loads chosen during fatigue testing were not kept constant in some cases. For example, five specimens of Al 7075-T6 were tested in the center crack configuration for process C at 12.5 ksi, while none were tested at this stress level for process A.

For the 13 comparisons made, none showed the baseline (process A) with a higher statistically significant mean, thereby suggesting that the FLASHJET process did not produce a degradation in the fatigue properties. In six cases, neither of the two processes showed a higher mean. The most interesting, and somewhat surprising, finding is that for five of the comparisons there was a statistically significant improvement in fatigue lifetimes for the FLASHJET-processed conditions. It appears that the temperatures resulting from the application of the FLASHJET process are conducive to alleviating some of the residual stresses associated with the center hole and the crack tip of the pre-cracked specimens. The alleviation of these stresses appears to increase somewhat the overall fatigue lifetimes of these specimens.

Table 3. Statistical analysis of process comparisons using the student's T function.

Alloy, Configuration	Stress (ksi)	Process Comparison	Difference in Mean at 95% Confidence
Al 2024-T3, center hole	13	A and B	Neither process higher
	10.5	A and B	Process B > process A
	10.5	A and C	Neither process higher
Al 2024-T3, center crack	12.5	A and B	Neither process higher
	12.5	A and C	Neither process higher
	11	A and B	Neither process higher
	11	A and C	Neither process higher
Al 7075-T6, center hole	12.5	A and B	Process B > process A
	12.5	A and C	Process C > process A
	10	A and B	Process B > process A
	10	A and C	Process C > process A
Al 7075-T6, center crack	11	A and B	Neither process higher
	10	A and C	Neither process higher

Kozol et al. (*7*) recently conducted high-cycle fatigue studies on the same two alloys of the same thickness to support FLASHJET qualification for the UH-60 helicopter. They used process parameters (flash frequency, voltage input and stripping head travel rate) that were identical to those used in the present study, including the Boeing-St. Louis FLASHJET facility. The significant differences between these two studies were that the present study: (1) also conducted tests with a crack configuration, (2) conducted crack growth rate studies, (3) performed FLASHJET to saturation and, most importantly, (4) machined the specimens prior to painting and FLASHJET paint removal. In 12 comparisons of baseline to FLASHJET-processed specimens, it was found that neither process gave a higher mean for ten cases, while two showed that the FLASHJET-processed specimens with a higher mean. They concluded that FLASHJET did not degrade fatigue life of these two alloys under the conditions tested.

Breihan and Reilly (*8*) earlier conducted low-cycle fatigue studies on the same two alloys of 0.032 in thickness and with identical dimensional configurations. They tested four groups: (1) baseline, (2) four painting-depainting cycles to primer, (3) four cycles to substrate, and (4) four cycles to saturation. Similar to Kozol, their specimens were machined from large panels that were painted and FLASHJET processed. Typically, the specimens had lifetimes of 10–20,000 cycles. Again, no differences in fatigue lifetimes were observed when comparing the four groups. It was concluded that FLASHJET processing did not or did little to degrade crack initiation life for these alloys tested under the stated conditions.

Another set of tests conducted by Kozol et al. (*7*) were hardness and conductivity measurements prior to and after each painting-depainting cycle. Both of these parameters, as well as mechanical properties such as fatigue, are influenced by exposure to elevated temperatures, typically greater than 300 °F. Temperature-sensitive adhesive strips on the back of specimens were used in the present study, and showed temperatures in the range of 200–250 °F during the

FLASHJET process, while Kozol et al. measured temperatures of 300–350 °F with similar strips. The difference in temperature observed may be due to the large panels absorbing more energy from the 12-in xenon lamp compared to the smaller fatigue coupons, with the former better representing the true depainting steps. In Kozol's study, no significant difference in either conductivity or hardness was found after any of the painting-depainting cycles. It was concluded that, although the temperature may have been high, the exposure time was far shorter than that required to degrade these properties. Beihan and Reilly also conducted hardness and conductivity measurements and similarly found no trends in these parameters during the FLASHJET cycles.

4.2 FLASHJET Process Control

The purpose of this study was to determine if the FLASHJET process affected the fatigue properties of two aluminum alloys. However, there was an observation made worthy of note regarding the uniformity of the FLASHJET process. Specifically, many of the test panels that had been stripped by the FLASHJET process displayed color variations during visual examination, as figures 8 and 9 reveal.

There are several important variables that control the stripping rate during the FLASHJET process, such as the input voltage, stripping head traverse rate, CO_2 feeder rate, and pelletizer pressure. The overall coating thickness and uniformity would also affect the stripping rate. In addition, the reflectivity characteristics of the coating being removed influence the amount of energy that will be absorbed by the coating and consequently the FLASHJET operating parameters. A highly reflective coating, such as the MIL-PRF-85285 white topcoat, used in this study for the first stripping cycle of the groups B and C test panels, would require a higher input energy in order to achieve a similar stripping rate as that of a less reflective coating. The topcoat used for the four remaining stripping cycles for the group C test panels was MIL-C-46168D Aircraft Green, which being a darker and less reflective coating would absorb more energy during stripping than the MIL-PRF-85285 white topcoat. The MIL-C-46168D Aircraft Green would therefore, most likely be quicker to remove than the MIL-PRF-85285 white topcoat, if the same stripping process parameters were utilized.

It can be deduced from this observation that the FLASHJET operating parameters must be established for each type of coating system because of such variables as gloss and color. The FLASHJET operating parameters must also be adjusted for differences in thickness which may present a challenge to an automated system. Otherwise, the FLASHJET process will not remove a particular coating evenly as witnessed in this study.

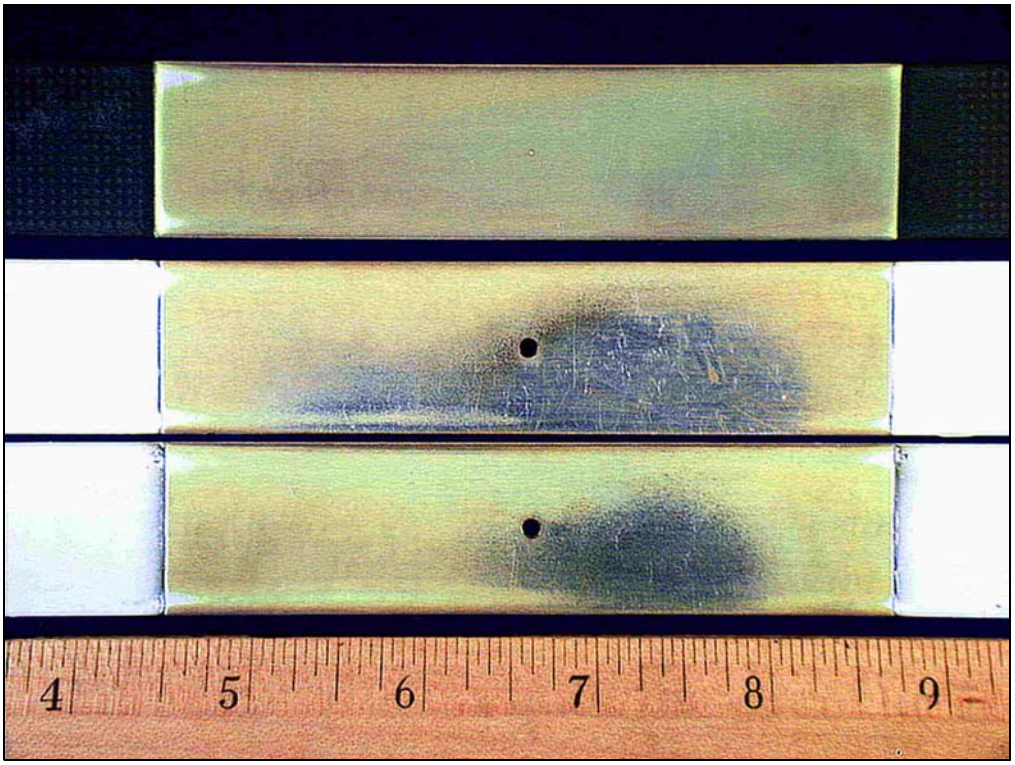

Figure 8. From top to bottom: specimen no. 36, 2024-T3 center crack, group B (fairly uniform surface, only primer and topcoat removed); specimen no. 08, 7075-T6 center hole, group B (uneven, some areas stripped to the substrate, topcoat not fully removed at bottom left of photograph); and specimen no. 06, 7075-T6 center hole, group B (uneven, some areas stripped to the substrate, topcoat not fully removed at bottom left of photograph).

5. Conclusions

Two aluminum alloys (Al 7075-T6 and Al 2024-T3), commonly used as skin substrates in aircraft, were tested in high-cycle fatigue using thin fatigue coupons that were machined prior to painting and paint removal by the FLASHJET process. The high-cycle fatigue properties of these alloys were not degraded by the FLASHJET paint-removal technique. This was true whether the specimens were depainted once to saturation (process B) or with five painting-depainting cycles (process C) simulating typical lifetime conditions. This finding concurs with other studies using similar testing parameters. Through a statistical analysis, the FLASHJET*-processed specimens showed a statistically significant improvement in fatigue lifetimes under several testing conditions. Therefore, FLASHJET should be further investigated as a paint removal technique by the Army and the other military services.

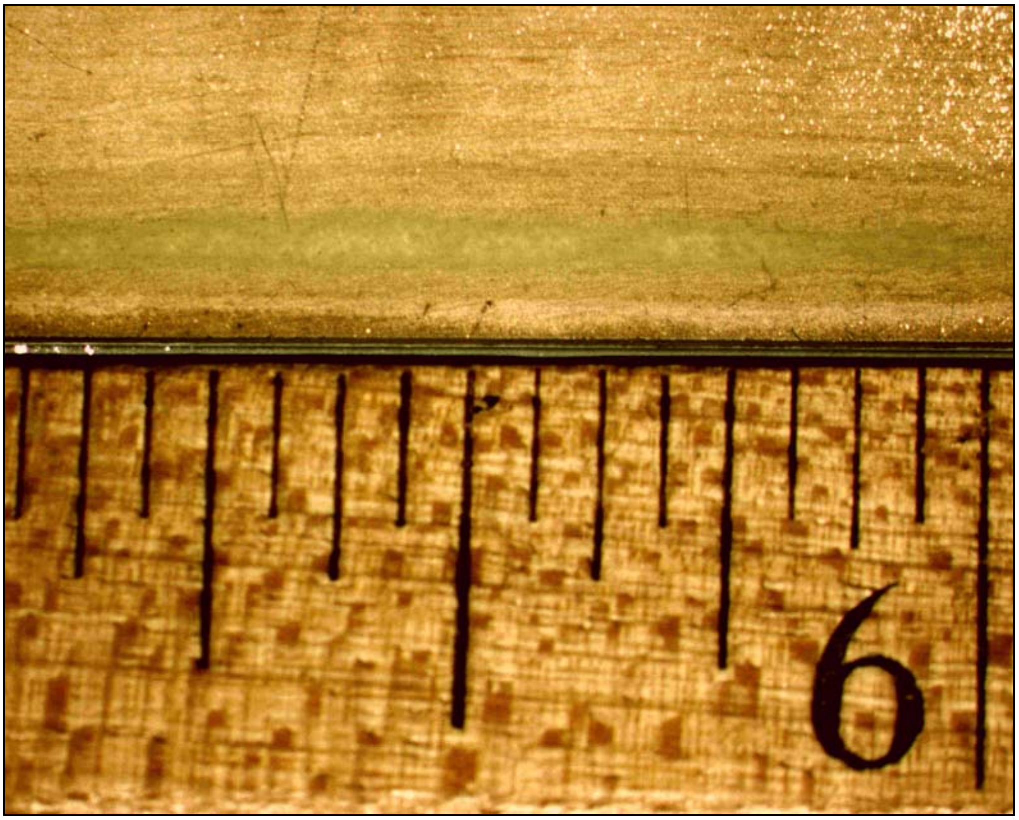

Figure 9. Enlargement of white topcoat not fully removed from specimen 06, from figure 8.

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INTENTIONALLY LEFT BLANK.

Appendix A. Crack Lengths Data

Table A-1. Total crack lengths for Al 2024-T3 produced by pre-cracking at a number of cycles with 300 lb and R = 0.1.

Specimen No.	Side 1 Crack (in)	Side 2 Crack (in)	Total Crack Length (in)	No. of Cycles at R = 0.1
1	0.01115	0.01211	0.05326	55000
2	0.01252	0.01312	0.05564	55000
3	0.01205	0.01190	0.05395	57500
4	0.01392	0.01365	0.05757	60000
5	0.01299	0.01392	0.05691	60000
6	0.01080	0.01252	0.05332	55000
7	0.01338	0.01431	0.05769	60000
8	0.01525	0.01268	0.05793	60000
9	0.01092	0.01045	0.05137	55000
10	0.01096	0.01037	0.05133	60000
11	0.01291	0.01264	0.05555	55000
12	0.01061	0.01217	0.05278	55000
13	0.01057	0.01385	0.05442	60000
14	0.01067	0.01181	0.05248	55000
15	0.01287	0.01166	0.05453	55000
16	0.01158	0.01065	0.05223	52500
17	0.01274	0.01189	0.05463	55000
18	0.01523	0.01634	0.06157	55000
40 Replaced 19	0.01186	0.01173	0.05359	55000
20	0.01342	0.01346	0.05688	55000
21	0.01053	0.01104	0.05157	45000
22	0.01158	0.01147	0.05305	55000
23	0.01299	0.01318	0.05617	55000
24	0.01096	0.01377	0.05473	55000
25	0.01073	0.01182	0.05255	55000
26	0.01275	0.01188	0.05463	50000
27	0.01069	0.01856	0.05925	58000
28	0.01069	0.01286	0.05355	55000
29	0.01209	0.01127	0.05336	60000
30	0.01026	0.01435	0.05461	55000
31	0.01377	0.01427	0.05804	55000
32	0.01108	0.01217	0.05325	55000
33	0.01037	0.01281	0.05318	55000
42 Replaced 34	0.01361	0.01228	0.05589	55000
35	0.01053	0.01096	0.05149	55000
36	0.01442	0.01404	0.05846	55000
37	0.01076	0.01049	0.05125	55000
38	0.01123	0.01265	0.05388	55000
39	0.01295	0.01143	0.05438	55000

Table A-2. Total crack lengths for Al 7075-T6 produced by pre-cracking at a number of cycles with 350 lb and R = 0.1.

Specimen No.	**Side 1 Crack (in)**	**Side 2 Crack (in)**	**Total Crack Length (in)**	**No. of Cycles at R = 0.1**
1	0.01459	0.01232	0.05691	60000
2	0.01170	0.01404	0.05574	60000
3	0.01307	0.01131	0.05438	60000
4	0.01112	0.01154	0.05266	80000
5	0.01724	0.01907	0.06631	115000
6	0.01318	0.01045	0.05363	95000
7	0.01264	0.01330	0.05594	70000
8	0.01170	0.01396	0.05566	55000
9	0.01279	0.01435	0.05714	65000
10	0.01246	0.01318	0.05564	60000
11	0.01316	0.01112	0.05428	70000
12	0.01431	0.01505	0.05936	67500
13	0.01322	0.01548	0.05870	77500
14	0.01287	0.01115	0.05402	60000
15	0.01131	0.01006	0.05137	60000
16	0.01412	0.01583	0.05995	67500
17	0.01170	0.01392	0.05562	65000
18	0.01049	0.01232	0.05281	65000
19	0.01065	0.01147	0.05212	60000
20	0.01178	0.01135	0.05313	60000
21	0.01108	0.01061	0.05169	70000
22	0.01166	0.01045	0.05211	65000
23	0.01034	0.01004	0.05038	62500
24	0.01372	0.01291	0.05663	62500
25	0.01353	0.01080	0.05433	62500
26	0.01108	0.01104	0.05212	60000
27	0.01236	0.01307	0.05543	62500
28	0.01166	0.01240	0.05406	62500
29	0.01228	0.01326	0.05554	62500
30	0.01548	0.01378	0.05926	75000
31	0.01073	0.01217	0.05390	67500
32	0.01158	0.01143	0.05301	60000
33	0.01310	0.01092	0.05402	65000
40 Replaced 34	0.01014	0.01100	0.05114	62500
35	0.01459	0.01160	0.05619	62500
36	0.01135	0.01353	0.05488	62500
37	0.01412	0.01104	0.05516	75000
38	0.01244	0.01357	0.05601	62500
39	0.01034	0.01189	0.05223	60000

Appendix B. Paint Removal Data

Table B-1. Paint removal per pass for group B (FLASHJET to substrate + three additional passes) Al 2024-T3 specimens.

Layout Location	Specimen No.	Coating Thickness (Right of Hole/Crack) (mil)																
		Left of	Right of	Pass No., Lamp Voltage														
				1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
				2300 V	**2300 V**	**2300 V**	**2000 V**	**2000 V**	**2000 V**	**2000 V**	**2000 V**	**2000 V**	**2000 V**	**2000 V**	**2000 V**	**2000 V**	**2000 V**	**2000 V**
Center Hole Al 2024-T3																		
1	8	5.35	5.94	—	—	—	—	—	—	—	S	SP 1	SP 2	SP 3	—	—	—	—
2	9	5.31	6.34	—	—	—	—	—	—	—	—	S	SP 1	SP 2	SP 3	—	—	—
3	10	5.08	5.98	5.04	3.94	2.90	2.65	2.04	1.29	0.66	0.37	0.24	S	SP 1	SP 2	SP 3	—	—
4	14	6.06	6.18	—	—	——	—	—	—	—	—	—	—	—	S	SP 1	SP 2	SP 3
5	15	6.42	6.54	—	—	—	—	—	—	—	—	—	S	SP 1	SP 2	SP 3	—	—
6	16	6.06	6.50	—	—	—	—	—	—	—	—	S	SP 1	SP 2	SP 3	—	—	—
7	17	5.51	6.34	5.12	4.02	2.89	2.41	1.07	0.64	0.34	0.26	S	SP 1	SP 2	SP 3	—	—	—
8	18	5.12	6.38	—	—	—	—	—	—	—	—	S	SP 1	SP 2	SP 3	—	—	—
9	19	5.16	6.18	—	—	—	—	—	—	—	—	S	SP 1	SP 2	SP 3	—	—	—
10	20	5.12	6.50	—	—	—	—	—	—	—	—	—	—	S	SP 1	SP 2	SP 3	—
11	22	6.10	6.38	5.20	4.21	3.00	1.98	1.20	0.67	0.39	0.28	0.24	—	S	SP 1	SP 2	SP 3	—
12	23	5.67	6.34	—	—	—	—	—	—	—	—	S	SP 1	SP 2	SP 3	—	—	—
Center Crack Al 2024-T3																		
13	1	5.20	4.92	—	—	—	—	—	—	S	SP 1	SP 2	SP 3	—	—	—	—	—
14	10	5.00	4.25	3.16	1.97	0.7—3	0.37	0.26	S	SP 1	SP 2	SP 3	—	—	—	—	—	—
15	11	4.76	4.37	—	—	—	—	—	—	S	SP 1	SP 2	SP 3	—	—	—	—	—
16	12	4.92	4.17	—	—	—	—	—	—	S	SP 1	SP 2	SP 3	—	—	—	—	—
17	13	4.65	4.25	—	—	—	—	—	—	S	SP 1	SP 2	SP 3	—	—	—	—	—
18	14	4.02	4.76	3.88	2.67	1.73	0.94	0.45	0.31	S	SP 1	SP 2	SP 3	—	—	—	—	—
19	15	4.33	4.72	—	—	—	—	—	S	SP 1	SP 2	SP 3	—	—	—	—	—	—
20	16	4.96	4.76	—	—	—	—	—	S	SP 1	SP 2	SP 3	—	—	—	—	—	—
21	17	4.92	4.76	—	—	—	—	—	—	S	SP 1	SP 2	SP 3	—	—	—	—	—
22	18	4.41	4.96	4.0—2	2.81	1.83	1.65	1.43	0.63	0.34	S	SP 1	SP 2	SP 3	—	—	—	—
23	20	4.13	4.29	—	—	—	—	—	—		S	SP 1	SP 2	SP 3	—	—	—	—
24	21	4.49	5.55	—	—	—	—	—	—	—	—	—	S	SP 1	SP 2	SP 3	—	—

Note: S = substrate; SP 1: saturation pass 1; SP 2: saturation pass 2; SP 3: saturation pass 3.

Table B-2. Amount of paint removal per pass for group B (FLASHJET to substrate + three additional passes) Al 7075-T6 specimens.

Layout Location	**Specimen No.**	**Thickness (Right of Hole/Crack) (mil)**												
		Left of	**Right of**	**Pass No., Voltage**										
				1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
				2300 V	**2300 V**	**2000 V**	**2000 V**	**2000 V**	**2000 V**	**2000 V**	**2000 V**	**2000 V**	**2000 V**	**2000 V**
Center Hole Al 7075-T6														
1	3	4.49	5.28	—	—	—	—	—	S	SP 1	SP 2	SP 3	—	—
2	5	5.12	6.34	—		—	—	—	—	S	SP 1	SP 2	SP 3	—
3	6	4.25	5.71	4.61	3.33	2.59	2.17	1.52	0.57	0.28	S	SP 1	SP 2	SP 3
4	8	4.09	5.31	—	—	—	—	—	S	SP 1	SP 2	SP 3	—	—
5	10	4.29	5.67	—	—	—	—	—	S	SP 1	SP 2	SP 3	—	—
6	12	4.49	5.43	—	—	—	—	—	S	SP 1	SP 2	SP 3	—	—
7	19	5.00	6.10	4.84	3.57	2.89	2.24	1.12	0.35	S	SP 1	SP 2	SP 3	—
8	22	4.57	5.12	—	—	—	—	—	—	S	SP 1	SP 2	SP 3	—
9	23	4.53	5.20	—	—	—	—	—	S	SP 1	SP 2	SP 3	—	—
10	24	4.25	5.39	—	—	—	—	—	—	S	SP 1	SP 2	SP 3	—
11	30	4.57	5.91	4.57	3.25	2.55	1.81	1.06	0.40	S	SP 1	SP 2	SP 3	—
12	31	5.20	6.02	—	—	—	—	—	S	SP 1	SP 2	SP 3	—	—
Center Crack Al 7075-T6														
13	1	3.82	4.76	—	—	—	—	S	SP 1	SP 2	SP 3	—	—	—
14	3	4.02	4.65	3.40	2.12	1.64	0.65	0.24	S	SP 1	SP 2	SP 3	—	—
15	5	3.58	4.88	—	—	—	—	—	S	SP 1	SP 2	SP 3	—	—
16	7	4.37	5.54	—	—	—	—	—	S	SP 1	SP 2	SP 3	—	—
17	10	3.69	4.65	—	—	—	—	S	SP 1	SP 2	SP 3	—	—	—
18	12	3.70	4.57	3.45	2.16	1.50	1.04	0.21	S	SP 1	SP 2	SP 3	—	—
19	16	4.57	5.94	—	—	—	—	S	SP 1	SP 2	SP 3	—	—	—
20	17	4.13	5.00	—	—	—	—	—	S	SP 1	SP 2	SP 3	—	—
21	18	3.88	4.76	—	—	—	—	—	S	SP 1	SP 2	SP 3	—	—
22	19	3.94	4.76	3.60	2.30	1.67	1.01	0.40	0.24	S	SP 1	SP 2	SP 3	—
23	21	3.56	4.88	—	—	—	—	—	—	S	SP 1	SP 2	SP 3	—
24	22	4.96	5.79	—	—	—	—	—	—	—	S	SP 1	SP 2	SP 3

Note: S = substrate; SP 1: saturation pass 1; SP 2: saturation pass 2; SP 3: saturation pass 3.

Table B-3. Paint removal per pass for group C (FLASHJET to substrate, five paint/depaint cycles) Al 7075-T6 specimens, cycle 1.

Layout Location		Coating Thickness (Right of Hole/Crack) (mil)																		
				Pass No., Lamp Voltage														
Cycle 1	Specimen No.	Left of	Right of	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
				2300 V	2300 V	2000 V	2000 V	2000 V	2000 V	2000 V	2000 V	2000 V	2000 V	2000 V	2000 V	2000 V	2000 V	2000 V
Center Hole Al 7075-T6																		
1	33	5.39	6.81	—	—	—	—	—	—	—	—	S*	—	—	—	—	—	—
2	35	5.08	6.26	—	—	—	—	—	—	—	—	—	—	—	—	S	—	—
3	37	4.88	6.06	4.16	3.53	3.01	2.82	2.02	1.09	0.41	0.25	0.24	0.23	0.22	0.24	S	—	—
4	38	3.98	5.28	—	—	—	—	—	—	—	—	S	—	—	—	—	—	—
5	42	4.69	5.71	—	—	—	—	—	S	—	—	—	—	—	—	—	—	—
6	43	4.29	5.39	—	—	—	—	—	—	S	—	—	—	—	—	—	—	—
7	44	4.49	5.83	4.41	3.15	2.66	2.26	1.06	0.31	S	—	—	—	—	—	—	—	—
8	45	4.37	5.43	—	—	—	—	—	—	S	—	S	—	—	—	—	—	—
9	46	5.24	6.14	—	—	—	—	—	—	—	—	S	—	—	—	—	—	—
10	47	4.54	5.47	—	—	—	—	—	—	—	S	—	—	—	—	—	—	—
11	48	4.92	5.94	4.65	3.49	3.16	2.94	2.44	1.46	0.51	0.36	0.26	0.25	0.24	0.26	0.25	0.25	0.24
12	49	4.33	5.39	—	—	—	—	—	S	—	—	—	—	—	—	# 48: Pass 16 - 2000 V: S		
Center Crack Al 7075-T6																		
13	24	4.69	5.71	—	—	—				S	—	—	—	—	—	—	—	—
14	25	3.91	5.16	3.77	2.55	2.14	1.58	0.39	0.24	S	—	—	—	—	—	—	—	—
15	26	4.06	4.88	—	—	—	—	—	S	—	—	—	—	—	—	—	—	—
16	29	4.65	5.75	—	—	—	—	—	—	—	S	—	—	—	—	—	—	—
17	30	4.84	5.79	—	—	—	—	—	—	—	—	—	—	S	—	—	—	—
18	31	4.57	5.51	4.29	2.93	2.50	2.28	0.69	S	—	—	—	—	—	—	—	—	—
19	32	3.85	4.96	—	—	—	—	—	S	—	—	—	—	—	—	—	—	—
20	33	3.91	4.96	—	—	—	—	—	S	—	—	—	—	—	—	—	—	—
21	35	3.84	4.80	—	—	—	—	—	S	—	—	—	—	—	—	—	—	—
22	36	4.06	4.84	3.98	2.85	2.59	2.30	1.46	0.53	0.23	S	—	—	—	—	—	—	—
23	37	3.65	4.80	—	—	—	—	—	—	—	S	—	—	—	—	—	—	—
24	39	4.80	5.75	—	—	—	—	—	—	—	—	S	—	—	—	—	—	—

Note: S = substrate.

Table B-4. Paint removal per pass for group C (FLASHJET to substrate, five paint/depaint cycles) Al 2024-T3 specimens, cycle 1.

Layout Location	Specimen	Thickness (Right of Hole/Crack) (mil)												
				Pass No., Voltage										
				1	2	3	4	5	6	7	8	9	10	11
Cycle 1	No.	Left of	Right of	2300 V	2300 V	2000 V	2000 V	2000 V	2000 V	2000 V	2000 V	2000 V	2000 V	2000 V
Center Hole Al 2024-T3														
1	24	5.43	6.34	—	—	—	—	—	—	—	—	S	—	—
2	25	5.24	6.38	—	—	—	—	—	—	—	—	—	S	—
3	26	5.08	6.38	5.08	3.94	3.29	2.83	1.94	0.76	0.38	0.39	0.24	S	—
4	27	5.04	6.06	—	—	—	—	—	—	—	—	—	—	S
5	28	5.28	6.38	—	—	—	—	—	S	—	—	—	—	—
6	29	5.16	6.30	—	—	—	—	—	—	—	—	S	—	—
7	31	4.80	5.87	4.45	3.29	2.77	1.60	0.57	0.28	S	—	—	—	—
8	32	4.65	5.63	—	—	—	—	—	—	S	—	—	—	—
9	33	4.84	5.67	—	—	—	—	—	—	S	—	—	—	—
10	34	5.12	6.06	—	—	—	—	—	—	—	—	S	—	—
11	35	4.80	5.67	4.37	3.24	2.23	1.87	0.68	0.25	0.27	0.26	S	—	—
12	41	5.00	6.34	—	—	—	—	—	—	S	—	—	—	—
Center Hole Al 2024-T3														
13	22	4.37	5.31	—	—	—	—	—	S	—	—	—	—	—
14	23	4.72	5.59	4.21	2.96	2.29	1.49	0.55	0.30	0.26	0.26	S	—	—
15	24	4.33	5.20	—	—	—	—	—	S	—	—	—	—	—
16	26	4.13	4.49	—	—	—	—	—	S	—	—	—	—	—
17	28	4.69	5.08	—	—	—	—	—	—	—	—	S	—	—
18	29	4.72	4.92	3.51	2.25	1.62	0.58	0.27	S	—	—	—	—	—
19	35	4.25	5.24	—	—	—	—	—	S	—	—	—	—	—
20	36	4.49	5.12	—	—	—	—	—	S	—	—	—	—	—
21	37	4.65	4.17	—	—	—	—	—	S	—	—	—	—	—
22	38	4.06	4.45	3.05	1.80	1.24	0.44	0.26	S	—	—	—	—	—
23	39	4.69	4.06	—	—	—	—	—	—	S	—	—	—	—
24	42	4.80	4.37	—	—	—	—	—	—	—	—	S	—	—

Note: S = substrate.

Table B-5. Paint removal for group C center hole Al 2024-T3, cycles 2–5.

Layout Location	Specimen No.	Coating Thickness (Right of Hole/Crack) (mil)									
		Pre-strip	Pass No., Lamp Voltage								
			1	2	3	4	5	6	7	8	9
			2300 V	2000 V	2000 V	2000 V	2000 V	2000 V	2000 V	2000 V	2000 V
Center Hole Al 2024-T3 - Cycle 2											
1	24	3.47	—	—	S*	—	—	—	—	—	—
2	25	3.22	—	—	S	—	—	—	—	—	—
3	26	3.26	0.36	0.24	S	—	—	—	—	—	—
4	27	3.28	—	—	S	—	—	—	—	—	—
5	28	2.62	—	—	S	—	—	—	—	—	—
6	29	3.03	—	—	S	—	—	—	—	—	—
7	31	3.36	0.53	0.26	S	—	—	—	—	—	—
8	32	3.73	—	S		—	—	—	—	—	—
9	33	3.64	—	S		—	—	—		—	—
10	34	3.28	—	—	S	—	—	—	—	—	—
11	35	3.55	0.36	0.25	S	—	—	—	—	—	—
12	41	3.15	—	—	S	—	—	—	—	—	—
Center Hole Al 2024-T3 - Cycle 3											
1	24	4.27	—	—	—	S	—	—	—	—	—
2	25	4.52	—	—	—	S	—	—	—	—	—
3	26	4.2	1.48	0.75	S	—	—	—	—	—	—
4	27	4.01	—	—	S	—	—	—	—	—	—
5	28	4.23	—	—	—	S	—	—	—	—	—
6	29	4.27	—	—	—	S	—	—	—	—	—
7	31	4.26	1.36	0.56	S	—	—	—	—	—	—
8	32	3.88	—	—	S	—	—	—	—	—	—
9	33	3.89	—	—	S	—	—	—	—	—	—
10	34	3.99	—	—	S	—	—	—	—	—	—
11	35	4.02	1.41	0.83	0.36	S	—	—	—	—	—
12	41	3.8	—	—	S	—	—	—	—	—	—
Center Hole Al 2024-T3 - Cycle 4											
1	24	3.76	—	—	—	—	—	—	S	—	—
2	25	3.55	—	—	—	—	—	—	S	—	—
3	26	3.74	0.63	0.21	S	—	—	—	—	—	—
4	27	3.69	—	—	S	—	—	—	—	—	—
5	28	3.73	—	—	—	—	—	S	—	—	—
6	29	3.85	—	—	—	—	—	S	—	—	—
7	31	3.66	0.7	0.31	0.26	0.26	0.26	S	—	—	—
8	32	3.57	—	—	—	—	—	S	—	—	—
9	33	3.26	—	—	—	—	—	S	—	—	—
10	34	3.52	—	—	—	—	—	S	—	—	—
11	35	3.26	0.71	0.26	0.29	0.26	S	—	—	—	—
12	41	3.55	—	—	—	—	—	S	—	—	—
Center Hole Al 2024-T3 - Cycle 5											
1	24	4.65	—	—	—	—	S	—	—	—	—
2	25	4.53	—	—	—	—	S	—	—	—	—
3	26	4.27	0.78	0.26	S	—	—	—	—	—	—
4	27	3.99	—	—	—	S	—	—	—	—	—
5	28	3.69	—	—	—	—	S	—	—	—	—
6	29	4.04	—	—	—	S	—	—	—	—	—
7	31	4.71	1.33	0.52	0.26	S	—	—	—	—	—
8	32	4.6	—	—	—	—	S	—	—	—	—
9	33	4.5	—	—	—	—	S	—	—	—	—
10	34	4.3	—	—	—	S	—	—	—	—	—
11	35	4.42	1.46	0.72	0.35	0.21	S	—	—	—	—
12	41	4.495	—	—	—	S	—	—	—	—	—

Note: S = substrate.

Table B-6. Paint removal for group C center crack Al 2024-T3, cycles 2–5.

Layout Location	Specimen No.	Coating Thickness (Right of Hole/Crack) (mil)									
		Pass No., Lamp Voltage									
		Pre-strip	1 2300 V	2 2000 V	3 2000 V	4 2000 V	5 2000 V	6 2000 V	7 2000 V	8 2000 V	9 2000 V
Center Crack Al 2024-T3 - Cycle 2											
13	22	3.62	—	—	S*	—	—	—	—	—	—
14	23	3.72	0.43	0.33	S	—	—	—	—	—	—
15	24	3.72	—	—	S	—	—	—	—	—	—
16	26	3.68	—	—	S	—	—	—	—	—	—
17	28	3.74	—	—	S	—	—	—	—	—	—
18	29	3.51	0.36	0.28	S	—	—	—	—	—	—
19	35	3.17	—	—	S	—	—	—	—	—	—
20	36	3.29	—	—	S	—	—	—	—	—	—
21	37	3.42	—	—	S	—	—	—	—	—	—
22	38	3.44	0.58	0.27	S	—	—	—	—	—	—
23	39	3.24	—	—	S	—	—	—	—	—	—
24	42	3.24	—	—	S	—	—	—	—	—	—
Center Crack Al 2024-T3 - Cycle 3											
13	22	4.44	—	—	S			—	—	—	—
14	23	4.33	1.2	0.53	S			—	—	—	—
15	24	4.41	—	—	S			—	—	—	—
16	26	4.38	—	—	—	S		—	—	—	—
17	28	4.41	—	—	—	S		—	—	—	—
18	29	4.43	1.45	0.7	S			—	—	—	—
19	35	4.58	—	—	—	S		—	—	—	—
20	36	4.54	—	—	—	S		—	—	—	—
21	37	4.58	—	—	—	S		—	—	—	—
22	38	4.69	1.85	1.42	0.71	0.5	S	—	—	—	—
23	39	4.76	—	—	—	—	S	—	—	—	—
24	42	4.82	—	—	—	—	S	—	—	—	—
Center Crack Al 2024-T3 - Cycle 4											
13	22	3.97	—	—	—	—	—	S	—	—	—
14	23	3.97	1.2	0.7	0.38	0.31	0.21	S	—	—	—
15	24	4.09	—	—	—	—	—	S	—	—	—
16	26	3.91	—	—	—	—	—	S	—	—	—
17	28	4.02	—	—	—	—	—	S	—	—	—
18	29	4.22	1.27	0.56	0.31	0.29	0.25	0.23	0.21	S	—
19	35	3.91	—	—	—	—	—	S	—	—	—
20	36	4.08	—	—	S	—	—	—	—	—	—
21	37	3.85	—	—	—	S	—	—	—	—	—
22	38	3.87	1.05	0.56	0.32	0.24	S	—	—	—	—
23	39	4.21	—	—	—	—	—	S	—	—	—
24	42	3.85	—	—	—	—	—	S	—	—	—
Center Crack Al 2024-T3 - Cycle 5											
13	22	4.305	—	—	S	—	—	—	—	—	—
14	23	4.42	1.25	0.42	0.24	S	—	—	—	—	—
15	24	4.33	—	—	S	S	—	—	—	—	—
16	26	4.29	—	—	—	S	—	—	—	—	—
17	28	4.28	—	—	—	—	—	S	—	—	—
18	29	4.17	0.79	0.24	0.26	0.23	S	—	—	—	—
19	35	4.14	—	—	—	S	—	—	—	—	—
20	36	3.91	—	—	—	S	—	—	—	—	—
21	37	4.14	—	—	—	—		S	—	—	—
22	38	4.4	1.23	0.63	0.35	0.22	S	—	—	—	—
23	39	4.45	—	—	—	S	—	—	—	—	—
24	42	4.25	—	—	—	S	—	—	—	—	—

Note: S = substrate.

Table B-7. Paint removal for group C center hole Al 7075-T6, cycles 2–5.

Layout Location	Specimen No.	Coating Thickness (Right of Hole/Crack) (mil)									
		Pass No., Lamp Voltage									
		Pre-strip	1 2300 V	2 2000 V	3 2000 V	4 2000 V	5 2000 V	6 2000 V	7 2000 V	8 2000 V	9 2000 V
Center Hole Al 7075-T6 - Cycle 2											
1	33	3.64	—	—	S*	—	—	—	—	—	—
2	35	3.47	—	—	S	—	—	—	—	—	—
3	37	3.36	0.29	0.21	S	—	—	—	—	—	—
4	38	3.28	—	—	S	—	—	—	—	—	—
5	42	3.34	—	—	S	—	—	—	—	—	—
6	43	3.42	—	—	S	—	—	—	—	—	—
7	44	3.27	0.67	0.22	S	—	—	—	—	—	—
8	45	3.01	—	—	S	—	—	—	—	—	—
9	46	3.32	—	—	S	—	—	—	—	—	—
10	47	3.13	—	—	S	—	—	—	—	—	—
11	48	3.59	0.72	0.31	S	—	—	—	—	—	—
12	49	3.52	—	—	S	—	—	—	—	—	—
Center Hole Al 7075-T6 - Cycle 3											
1	33	3.84	—	—	S	—	—	—	—	—	—
2	35	3.56	—	—	S	—	—	—	—	—	—
3	37	3.53	0.63	S	—	—	—	—	—	—	—
4	38	3.54	—	—	S	—	—	—	—	—	—
5	42	3.89	—	—	S	—	—	—	—	—	—
6	43	4.1	—	—	S	—	—	—	—	—	—
7	44	4.5	1.49	0.77	S	—	—	—	—	—	—
8	45	4.48	—	—	S	—	—	—	—	—	—
9	46	4.67	—	—	S	—	—	—	—	—	—
10	47	4.85	—	—		S	—	—	—	—	—
11	48	4.85	1.71	1.21	0.74	S	—	—	—	—	—
12	49	4.72	—	—	—	S	—	—	—	—	—
Center Hole Al 7075-T6 - Cycle 4											
1	33	4.29	—	—	—	—	S	—	—	—	—
2	35	4.1	—	—	—	—		S	—	—	—
3	37	4	0.64	0.29	0.28	0.26	0.25	0.24	S	—	—
4	38	3.92	—	—	—	—	S	—	—	—	—
5	42	4.2	—	—	—	—	—	—	—	S	—
6	43	4.07	—	—	—	—	S	—	—	—	—
7	44	4.56	1.03	0.47	0.28	0.24	0.23	0.23	0.22	S	—
8	45	4.31	—	—	—	—	S	—	—	—	—
9	46	4.31	—	—	—	—	S	—	—	—	—
10	47	4.23	—	—	—	—	—	S	—	—	—
11	48	4.32	1.2	0.59	0.28	0.23	0.21	0.21	S	—	—
12	49	4.4	—	—	—	—	—	S	—	—	—
Center Hole Al 7075-T6 - Cycle 5											
1	33	4.2	—	—	—	S	—	—	—	—	—
2	35	4.32	—	—	S	—	—	—	—	—	—
3	37	4.46	0.89	0.23	S	—	—	—	—	—	—
4	38	4.24	—	—	—	S	—	—	—	—	—
5	42	4.3	—	—	—	—	—	—	—	S	—
6	43	4.23	—	—	—	—	—	S	—	—	—
7	44	4.79	1.52	0.65	0.21	S	—	—	—	—	—
8	45	4.58	—	—	—	S	—	—	—	—	—
9	46	4.34	—	—	S	—	—	—	—	—	—
10	47	4.18	—	—	—	S	—	—	—	—	—
11	48	4.07	1.21	0.58	0.36	0.29	S	—	—	—	—
12	49	3.97	—	—	—	S	—	—	—	—	—

Note: S = substrate.

Table B-8. Paint removal for group C center crack Al 7075-T6, cycles 2–5.

Layout Location	Specimen No.	Coating Thickness (Right of Hole/Crack) (mil)									
		Pass No., Lamp Voltage									
		Pre-strip	1 2300 V	2 2000 V	3 2000 V	4 2000 V	5 2000 V	6 2000 V	7 2000 V	8 2000 V	9 2000 V
Center Crack Al 7075-T6 - Cycle 2											
13	24	3.71	—	—	S*	—	—	—	—	—	—
14	25	3.51	0.68	0.22	S	—	—	—	—	—	—
15	26	3.54	—	—S	—	—	—	—	—	—	—
16	29	3.51	—	—	S	—	—	—	—	—	—
17	30	3.63	—	—	S	—	—	—	—	—	—
18	31	3.45	0.36	S	—	—	—	—	—	—	—
19	32	3.43	—	—	S	—	—	—	—	—	—
20	33	3.71	—	—	S	—	—	—	—	—	—
21	35	3.59	—	—	S	—	—	—	—	—	—
22	36	3.61	0.64	0.34	S	—	—	—	—	—	—
23	37	3.42	—	—	—	S	—	—	—	—	—
24	39	3.34	—	—	S	—	—	—	—	—	—
Center Crack Al 7075-T6 - Cycle 3											
13	24	4.39	—	—	S	—	—	—	—	—	—
14	25	4.17	1.21	0.47	S	—	—	—	—	—	—
15	26	4.18	—	—	S	—	—	—	—	—	—
16	29	4.24	—	—	—	S	—	—	—	—	—
17	30	4.29	—	—	—	S	—	—	—	—	—
18	31	4.34	1.36	0.59	S	—	—	—	—	—	—
19	32	3.81	—	—	S	—	—	—	—	—	—
20	33	4.48	—	—	—	S	—	—	—	—	—
21	35	4.5	—	—	—	S	—	—	—	—	—
22	36	4.58	1.56	1.15	0.54	S	—	—	—	—	—
23	37	4.87	—	—	—	—	S	—	—	—	—
24	39	4.52	—	—	—	S	—	—	—	—	—
Center Crack Al 7075-T6 - Cycle 4											
13	24	3.78	—	—	—	—	S	—	—	—	—
14	25	3.83	1.2	0.53	0.35	0.25	S	—	—	—	—
15	26	3.83	—	—	—	—	—	—	—	—	S
16	29	3.56	—	—	—	—	S	—	—	—	—
17	30	3.85	—	—	—	—	S	—	—	—	—
18	31	3.92	1.06	0.51	0.26	0.25	S	—	—	—	—
19	32	4.29	—	—	—	—	—	—	S	—	—
20	33	3.93	—	—	—	—	—	—	—	—	S
21	35	4.05	—	—	—	—	—	—	S	—	—
22	36	4.05	1.55	0.82	0.46	0.35	0.26	0.22	S	—	—
23	37	4.34	—	—	—	—	—	—	—	—	S
24	39	4.12	—	—	—	—	—	—	S	—	—
Center Crack Al 7075-T6 - Cycle 5											
13	24	4.26	—	—	—	S	—	—	—	—	—
14	25	4.85	1.56	0.85	0.38	0.34	0.29	0.25	0.23	S	—
15	26	4.76	—	—	—	—	—	—	—	S	—
16	29	4.52	—	—	—	S	—	—	—	—	—
17	30	4.74	—	—	—	—	—	S	—	—	—
18	31	4.58	1.28	0.65	0.32	S	—	—	—	—	—
19	32	4.57	—	—	—	S	—	—	—	—	—
20	33	4.7	—	—	—	—	—	—	—	S	—
21	35	4.51	—	—	—	—	—	—	—	S	—
22	36	4.51	1.24	0.71	0.33	0.26	0.25	0.24	0.21	S	—
23	37	4.2	—	—	—	—	—	—	—	S	—
24	39	4.38	—	—	—	—	—	—	—	S	—

Note: S = substrate.

INTENTIONALLY LEFT BLANK.

Appendix C. Fatigue Data

C-1. Fatigue data for Al 7075-T6 in the center hole configuration for processes A, B, and C.

Sample No.	Max. Stress (ksi)	Max Load (lb)	Mean Load (lb)	Load Amp. (lb)	Final Cycles	Failure Location
Process A						
2	13	330.9	182.0	148.9	84,155	Hole
7	13	328.1	180.4	147.7	101,075	Hole
11	12.5	314.7	173.1	141.6	105,162	Hole
15	12.5	318.6	175.2	143.4	117,846	Hole
26	12.5	316.9	174.3	142.6	122,124	Hole
25	12.5	316.8	174.2	142.6	104,994	Hole
21	12.5	317.7	174.7	143.0	103,964	Hole
13	12.5	315.8	173.7	142.1	126,666	Hole
1	10.5	265.7	146.2	119.6	649,792	Hole
4	10.5	265.3	145.9	119.4	279,438	Hole
9	10	252.9	139.1	113.8	411,210	Hole
14	10	252.4	138.8	113.6	365,178	Hole
20	10	251.8	138.5	113.5	505,506	Hole
16	10	258.1	141.9	116.2	304,025	Hole
27	10	254.6	140.0	114.6	261,593	Hole
41	10	252.1	138.6	113.5	309,010	Hole
28	10	253.9	139.6	114.3	625,456	Grip
18	10	251.2	138.2	113.0	549,175	Grip
17	10	252.4	138.8	113.6	1,131,975	Grip
Process B						
3	12.5	321.9	177	144.9	295,616	Hole
31	12.5	323	177.6	145.4	299,857	Hole
30	12.5	323.5	177.9	145.6	194,387	Hole
24	12.5	322.1	177.2	144.9	325,364	Hole
23	12.5	322.8	177.5	145.3	141,152	Hole
22	12.5	324.1	178.3	145.8	252,939	Hole
5	10	259	142.4	116.6	2,026,900	Grip
12	10	258.4	142.1	116.3	3,000,000	DISCO
10	10	257.4	141.6	115.8	287,679	Hole
8	10	258.6	142.2	116.4	3,000,000	DISCO
6	10	257	141.4	115.6	3,000,000	DISCO
19	10	256.9	141.3	115.6	1,208,557	Hole
Process C						
35	12.5	320	176	144	135,794	Hole
37	12.5	318	175	143	916,968	Hole
46	12.5	317	174.6	142.8	291,277	Hole
44	12.5	318	175	143	442,206	GRIP
42	12.5	318	175	143	3,000,000	DISCO
49	12.5	320	176.1	144.1	INVALID	—
47	10	258.2	142	116.2	1,016,300	GRIP
33	10	254	140	114	3,000,000	DISCO
38	10	255	140	114	3,000,000	DISCO
45	10	256	141	115	INVALID	Buckled
48	10	259	142.6	116.7	2,230,245	GRIP
43	10	255	140	114	1,299,597	GRIP

Table C-2. Fatigue data for Al 7075-T6 in the center crack configuration for processes A, B, and C.

Sample No.	Max. Stress (ksi)	Max Load (lb)	Mean Load (lb)	Load Amp. (lb)	Final Cycles	Failure Location
Process A						
4	11	270	148	122	289,419	Hole
6	11	271	149	122	244,362	Hole
8	11	268	148	120	236,917	Hole
9	11	270	148	122	257,594	Hole
11	11	271	149	122	234,324	Hole
13	11	268	148	120	255,181	Hole
14	11	271	149	122	255,861	Hole
15	10.5	260	143	117	300,336	Hole
20	10	244	134	110	315,250	Hole
23	10	248	136	112	3,000,000	Disco
27	10	246	136	110	299,152	Hole
28	10	246	136	110	280,842	Hole
40	10	249	137	112	266,105	Hole
38	10	248	136	112	509,036	Hole
Process B						
3	11	273	150	123	318,627	Hole
5	11	268	148	120	265,547	Hole
7	11	272	150	122	260,759	Hole
10	11	271	149	122	334,810	Hole
12	11	267	147	120	279,402	Hole
17	11	273	150	123	242,256	Hole
18	11	273	150	123	228,643	Hole
1	10	246	136	110	47,070?	Hole
19	10	250	138	112	523,606	Hole
22	10	245	134	111	213,872	Hole
21	10	248	136	112	362,251	Hole
Process C						
39	13.8	350	192.5	157.5	100.045	Hole
30	12.5	315	175	140	138,527	Hole
31	12.5	316.4	174	142	117,117	Hole
35	12.5	316.4	173.8	142.2	79,998	Hole
32	12.5	316.1	174	142	140,523	Hole
33	12.5	317.5	175	143	99,016	Hole
26	11	278	152.9	125.1	238,154	Hole
24	11	280.8	154.5	126.5	175,004	Hole
37	10.5	266.2	146.4	119.8	231,098	Hole
36	10	252	138	113	308,338	Hole
25	8	203.3	111.8	91.5	3,000,000	Disco

Table C-3. Fatigue data for Al 2024-T3 in the center hole configuration for processes A, B, and C.

Sample No.	Max. Stress (ksi)	Max Load (lb)	Mean Load (lb)	Load Amp. (lb)	Final Cycles	Failure Location
Process A						
2	25	636	321.2	314.8	31,978	Gage
1	15	380	209	171	143,951	Gage
3	15	380	209	171	133,966	Gage
5	13	329	180.9	148.1	274,902	Gage
11	13	330	181.7	148.7	198,971	Gage
40	13	332	182.6	149.4	232,320	Gage
42	13	328	180.4	147.6	203,259	Gage
43	13	328	180.9	148.1	221,814	Gage
44	13	329	180.9	148.1	162,743	Gage
6	12	304	167.2	136.8	282,855	Gage
7	10.5	264	145.2	118.8	641,991	Gage
45	10.5	266	146.3	119.7	309,896	Gage
30	10.5	265	145.8	119.2	498,805	Gage
37	10.5	267	146.8	120.2	333,433	Gage
36	10.5	266	146.3	119.7	352,652	Gage
21	10.5	264	145.2	118.8	371,038	Gage
4	10	254	139.7	114.3	3,000,000	Gage
Process B						
16	13	334.9	184.2	150.7	170,497	Gage
23	13	336	184.8	151.2	185,310	Gage
18	13	334.5	183.9	150.6	189,909	Gage
19	13	336.3	184.9	151.4	198,904	Gage
20	13	337.3	185.5	151.8	223,794	Gage
17	13	335.5	184.6	151	228,047	Gage
14	10.5	273.9	150.6	123.3	545,017	Gage
10	10.5	270.8	148.9	121.9	596,898	Gage
22	10.5	270.7	148.9	121.8	766,899	Gage
8	10.5	270	148.5	121.5	1,697,339	Gage
15	10.5	270.8	148.9	121.9	2,258,006	Gage
9	10.5	271.4	149.3	122.1	3,000,000	DISCO
Process C						
41	12.5	316	174	142	301,420	Hole
32	12.5	320	176	144	781,168	Hole
29	12.5	317	174	143	487,852	Hole
26	12.5	322	177	145	314,272	Hole
24	12.5	319	175	144	329,144	Hole
34	10.5	268	148	120	113,171	Grip
33	10.5	266	146	120	709,079	Hole
31	10.5	266	146	120	654,538	Hole
28	10.5	266	146	120	645,506	Hole
27	10.5	268	148	120	507,457	Hole
25	10.5	267	147	120	618,973	Hole
35	10	255	140	115	2,968,099	Hole

Table C-4. Fatigue data for Al 2024-T3 in the center crack configuration for processes A, B, and C.

Sample No.	Max. Stress (ksi)	Max Load (lb)	Mean Load (lb)	Load Amp. (lb)	Final Cycles	Failure Location
Process A						
25	12.5	315	174	141	445,632	HOLE
27	12.5	315	174	141	403,531	HOLE
30	12.5	312	172	140	425,312	HOLE
31	12.5	312	172	140	352,549	HOLE
32	12.5	312	172	140	468,004	HOLE
33	12.5	312	172	140	430,457	HOLE
2	11	276	152	124	618,761	HOLE
4	11	276	152	124	3,000,000	DISCO
5	11	278	153	125	550,059	HOLE
6	11	275	152	124	1,401,699	HOLE
8	11	276	152	124	3,000,000	DISCO
9	11	275	152	123	766,018	HOLE
7	11	275	151	124	486,011	HOLE
40	10	248	136	112	1,039,310	HOLE
Process B						
13	12.5	312	172	140	594,181	HOLE
14	12.5	312	172	140	1,370,264	HOLE
15	12.5	312	172	140	1,025,740	HOLE
16	12.5	312	172	140	521,426	HOLE
10	11	275	152	123	3,000,000	DISCO
11	11	276	152	124	727,500	HOLE
12	11	275	152	123	1,208,382	HOLE
17	11	275	152	123	1,643,358	HOLE
18	11	275	152	124	532,656	HOLE
20	11	276	155	124	2,227,188	HOLE
21	11	275	152	123	844,952	HOLE
Process C						
42	18.8	480	264	216	80,022	Hole
38	12.5	319.7	176	144	560,936	Hole
26	12.5	320	176	144	380,365	Hole
24	12.5	317	174	143	453,181	Hole
23	12.5	322	177	145	392,754	Hole
22	12.5	320	176	144	374,575	Hole
39	11	280	154	126	2,518320	Hole
36	11	282	155	127	3,000,000	Disco
35	11	284	156	128	938,662	Hole
28	11	286	158	128	874,870	Hole
29	10	258	142	116	809,502	Hole

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Appendix D. DA/DN Data for Al 7075-T6

Table D-1. DA/DN data for Al 7075-T6 in the center crack configuration with one specimen for each process.

Process A			
Cycles	Length (in)	Δ K (psi-in$^{1/2}$)	da/dN (in/Cyc)
11264	0.0625	4042.5	5.5778E-07
13712	0.0646	4159.2	6.2581E-07
15344	0.0669	4206.4	6.2504E-07
16568	0.069	4245.2	5.8069E-07
18405	0.0711	4322.6	5.8498E-07
20445	0.0732	4376.6	5.3630E-07
23099	0.0754	4440.7	5.0940E-07
24935	0.0775	4496.1	5.0961E-07
27178	0.0796	4557.3	5.4398E-07
29218	0.082	4623.8	6.0663E-07
31461	0.0842	4714.3	7.0119E-07
33093	0.0865	4791.9	8.2598E-07
34521	0.0891	4875.9	9.1835E-07
35746	0.0916	4925.1	9.5495E-07
36766	0.0939	4978.4	9.8079E-07
37990	0.0964	5037.8	9.7814E-07
39215	0.0987	5085.8	9.7563E-07
40234	0.1008	5149.5	9.8764E-07
41457	0.103	5202.6	1.0690E-06
42476	0.1051	5248.6	1.1594E-06
43496	0.1074	5324.7	1.3225E-06
44312	0.1098	5368.6	1.4852E-06
45128	0.1121	5423.1	1.6669E-06
45740	0.1143	5473.8	1.7568E-06
46353	0.1168	5535.5	1.7900E-06
46966	0.119	5606	1.8334E-06
47577	0.1215	5666.4	1.8234E-06
48394	0.1236	5716.9	1.8906E-06
49210	0.1263	5795.4	2.0542E-06
49822	0.1292	5852.1	2.1848E-06
50434	0.1321	5907.7	2.3105E-06
50841	0.1348	5956.9	2.4015E-06
51452	0.1369	6040.6	2.4758E-06
52064	0.1397	6091.8	2.6333E-06
52675	0.1428	6181.9	2.9062E-06
53084	0.146	6221.6	3.1182E-06
53492	0.1483	6289	3.3386E-06

Process B			
Cycles	Length (in)	Δ K (psi-in$^{1/2}$)	da/dN (in/Cyc)
13299	0.0687	4225	2.7982E-07
17785	0.071	4298	3.1786E-07
21662	0.0733	4359.2	3.4211E-07
23496	0.0754	4407.7	3.3642E-07
25740	0.0775	4453.7	3.5546E-07
29821	0.0796	4528.3	3.5422E-07
33494	0.0819	4603.9	3.6874E-07
36351	0.084	4670.7	4.0868E-07
39003	0.0861	4723.4	3.8145E-07
41246	0.0885	4771.1	4.0580E-07
43490	0.0908	4824.6	3.9915E-07
48796	0.093	4938.3	3.7524E-07
50632	0.0954	4948.4	4.0431E-07
54302	0.0979	5041.8	4.9399E-07
56546	0.1002	5090.6	5.5818E-07
57770	0.1023	5117.2	5.2055E-07
59810	0.104401	5193.1	5.7951E-07
61442	0.1068	5254.8	6.0696E-07
64298	0.1089	5311.7	6.2295E-07
65522	0.1111	5353.8	6.6675E-07
66746	0.1133	5402.1	7.4510E-07
68990	0.1157	5490.3	9.1027E-07
70012	0.118	5530.7	9.7084E-07
71236	0.1202	5573.5	1.0872E-06
72460	0.1232	5655.7	1.1885E-06
73480	0.1259	5717.4	1.2547E-06
74500	0.1281	5806.1	1.2942E-06
75521	0.1311	5850.1	1.2989E-06
76133	0.1334	5897.1	1.3227E-06
77152	0.1356	5936.5	1.3301E-06
78173	0.1381	5991.6	1.3861E-06
79192	0.1404	6066.5	1.4743E-06
80007	0.1433	6134.2	1.6312E-06
80823	0.146	6170.5	1.7971E-06
81436	0.1485	6219.8	1.8958E-06
82048	0.1507	6277.9	1.9816E-06
82659	0.1534	6325.3	2.0942E-06

Process C			
Cycles (in)	Length (lb)	Δ K (psi-in$^{1/2}$)	da/dN (in/Cyc)
21863	0.0746	4378	5.4204E-07
26216	0.0797	4509	5.9316E-07
31518	0.0852	4690.8	6.7568E-07
35238	0.0903	4801.8	8.1166E-07
38644	0.0957	4960	9.6356E-07
40938	0.1009	5063.8	1.0210E-06
43234	0.1059	5185.8	1.1343E-06
45608	0.1118	5321.2	1.2829E-06
48140	0.1171	5479.3	1.3975E-06
49407	0.1221	5548.9	1.4750E-06
50832	0.1271	5664.6	1.5619E-06
52890	0.1323	5806.6	1.7696E-06
54393	0.1378	5932.3	1.9724E-06
56056	0.1435	6069.9	2.3493E-06
56768	0.149	6141.1	2.5742E-06
57876	0.154	6259	3.0778E-06
58747	0.1595	6374.1	3.4495E-06
59459	0.164599	6478.9	3.7248E-06
60093	0.1696	6580.8	3.9803E-06
60806	0.1758	6707.1	4.2259E-06
61440	0.181	6803.1	4.5297E-06
62072	0.1866	6930.1	4.9471E-06
62626	0.192	7044.4	5.3223E-06
63022	0.1972	7118.3	5.7136E-06
63498	0.2025	7218.8	6.1037E-06
63972	0.2081	7349.9	6.1180E-06
64289	0.2133	7433.9	6.1193E-06
64764	0.2183	7540	6.2067E-06
65319	0.2243	7655.7	6.2891E-06
65714	0.2298	7766.3	6.5044E-06
66110	0.2355	7839.8	6.6811E-06
66506	0.2407	7961.7	7.0877E-06
66822	0.245799	8055.8	7.1284E-06
67297	0.251	8178	7.2216E-06
67614	0.2572	8256.6	7.2578E-06
68010	0.2627	8375.5	7.2714E-06
68406	0.268	8476.4	7.2850E-06

Table D-1. DA/DN data for Al 7075-T6 in the center crack configuration with one specimen for each process (continued).

Process A			
Cycles	**Length (in)**	**Δ K (psi-in$^{1/2}$)**	**da/dN (in/Cyc)**
53900	0.151	6338.4	3.5339E-06
54308	0.154	6398.9	3.6351E-06
54717	0.1569	6461.1	3.6211E-06
55125	0.1601	6521.1	3.5079E-06
55533	0.1631	6581.2	3.3933E-06
55942	0.1659	6625.4	3.3094E-06
56349	0.1686	6691.7	3.3670E-06
56960	0.171	6793.9	3.6423E-06
57368	0.1748	6865.7	3.8967E-06
57776	0.178	6911.6	4.1064E-06
58183	0.1818	6996.6	4.2977E-06
58591	0.1849	7066.6	4.3941E-06
58998	0.1887	7136.2	4.4850E-06
59406	0.1921	7209.1	4.5494E-06
59814	0.1958	7292.7	4.6186E-06
60222	0.1997	7378.8	4.7498E-06
60630	0.2037	7458.6	4.9029E-06
61038	0.207	7492.9	5.1259E-06
61242	0.2113	7555.3	5.2312E-06
61446	0.2135	7592.9	5.2902E-06
61650	0.2157	7671.9	5.2922E-06
61855	0.2178	7670.6	5.2650E-06
62058	0.22	7719.2	5.3173E-06
62263	0.2221	7789.3	5.3771E-06
62467	0.2243	7852.1	5.4432E-06
62671	0.2264	7908.6	5.5439E-06
63080	0.2288	7981.1	5.7586E-06
63284	0.2333	8009.8	5.8412E-06
63488	0.2357	8058.7	5.9165E-06
63692	0.2381	8104.3	5.9544E-06
63896	0.2406	8158.3	6.0935E-06
64099	0.243	8216.2	6.2751E-06
64304	0.2455	8227.5	6.3927E-06
64508	0.2478	8296.5	6.6745E-06
64712	0.2508	8332	6.8583E-06
64915	0.2536	8386.8	7.0888E-06
65119	0.2561	8461	7.1266E-06
65323	0.2594	8499.5	7.1442E-06
65527	0.2621	8600.7	7.0709E-06

Process B			
Cycles	**Length (in)**	**Δ K (psi-in$^{1/2}$)**	**da/dN (in/Cyc)**
83272	0.1559	6409.5	2.1792E-06
83884	0.1584	6410.8	2.2603E-06
84497	0.161	6521.8	2.4040E-06
85108	0.1639	6569.2	2.5850E-06
85517	0.1669	6614.7	2.6860E-06
85925	0.169	6661.8	2.7587E-06
86332	0.1713	6706	2.8317E-06
86741	0.1737	6750.3	2.9021E-06
87149	0.176	6812.5	2.9234E-06
87556	0.1783	6860.2	3.0408E-06
87965	0.1807	6939.1	3.1160E-06
88373	0.1833	6951.8	3.1201E-06
88781	0.1856	7025	3.0723E-06
89189	0.1888	7075.3	3.0168E-06
89597	0.1911	7110.2	2.9952E-06
90004	0.1933	7167	2.9435E-06
90412	0.1956	7227.1	3.0480E-06
90820	0.1981	7254.7	3.1961E-06
91227	0.2007	7340.6	3.2998E-06
91636	0.2032	7372.1	3.3830E-06
92044	0.206	7444.4	3.4527E-06
92452	0.209	7495.6	3.5881E-06
92860	0.2117	7539	3.6819E-06
93268	0.2146	7612.6	3.7976E-06
93676	0.2175	7653.1	3.9695E-06
94083	0.221	7739.5	4.1316E-06
94490	0.2241	7767.5	4.2374E-06
94898	0.2275	7863.6	4.1977E-06
95306	0.2311	7922.1	4.1446E-06
95713	0.2348	8040.3	3.9990E-06
96121	0.2382	8067.7	3.8493E-06
96528	0.2411	8118.9	3.7965E-06
96937	0.2442	8183.3	3.7434E-06
97345	0.2471	8205.9	3.7785E-06
97752	0.2502	8321.9	3.8770E-06
98160	0.2537	8364.1	4.1045E-06
98568	0.2563	8417.6	4.3967E-06
98771	0.2596	8464.8	4.4341E-06
98975	0.2617	8483.5	4.6955E-06

Process C			
Cycles (in)	**Length (lb)**	**Δ K (psi-in$^{1/2}$)**	**da/dN (in/Cyc)**
68802	0.2735	8575.9	7.3502E-06
69198	0.2793	8665.6	7.5907E-06
69594	0.2857	8802.9	7.7920E-06
69910	0.2908	8877	7.9447E-06
70227	0.2965	8975.5	8.0764E-06
70544	0.3015	9074.8	8.2218E-06
70860	0.3066	9162.7	8.1599E-06
71177	0.3119	9221.1	8.3870E-06
71573	0.3172	9373	8.7539E-06
71890	0.3234	9482.2	9.0735E-06
72127	0.3288	9567.5	9.5374E-06
72444	0.3339	9693	9.9709E-06
72760	0.3398	9807.7	1.0056E-05
73078	0.3459	9956.7	9.8238E-06
73394	0.3536	10047.5	9.5278E-06
73711	0.3594	10163.2	9.2820E-06
74028	0.365	10309.6	8.9001E-06
74344	0.3707	10362.3	8.9949E-06
74660	0.3758	10480.4	9.1972E-06
74978	0.3822	10601.7	9.3347E-06
75294	0.3874	10691.4	9.5184E-06
75611	0.3938	10810.1	9.6868E-06
75927	0.4001	10925.6	9.9804E-06
76244	0.4058	11062.7	1.0213E-05
76561	0.4121	11206.5	1.0581E-05
76878	0.419	11327.6	1.0875E-05
77115	0.4256	11453.4	1.1357E-05
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Table D-1. DA/DN data for Al 7075-T6 in the center crack configuration with one specimen for each process (continued).

Process A				Process B				Process C			
Cycles	**Length (in)**	**Δ K (psi-in$^{1/2}$)**	**da/dN (in/Cyc)**	**Cycles**	**Length (in)**	**Δ K (psi-in$^{1/2}$)**	**da/dN (in/Cyc)**	**Cycles (in)**	**Length (lb)**	**Δ K (psi-in$^{1/2}$)**	**da/dN (in/Cyc)**
65730	0.2653	8684.3	6.8791E-06	99384	0.2638	8562.7	4.8198E-06	—	—	—	—
65934	0.2681	8665.6	6.8951E-06	99791	0.2676	8647.3	4.7458E-06	—	—	—	—
66138	0.2708	8718.1	7.1370E-06	99996	0.2714	8672.5	4.7567E-06	—	—	—	—
66342	0.2734	8787.4	7.5768E-06	100404	0.2736	8751.8	4.8108E-06	—	—	—	—
66546	0.2762	8850.4	7.8596E-06	100812	0.2773	8835.6	4.7656E-06	—	—	—	—
66750	0.2793	8888.1	7.9959E-06	101016	0.2811	8853.9	4.6556E-06	—	—	—	—
66953	0.2832	8987.1	7.8815E-06	101424	0.2833	8917.5	4.5828E-06	—	—	—	—
67157	0.2867	9019.6	7.5118E-06	101832	0.2873	8987	4.4156E-06	—	—	—	—
67362	0.2895	9076.5	7.0863E-06	102241	0.2908	9042.7	4.3869E-06	—	—	—	—
67566	0.2925	9125.4	6.9355E-06	102648	0.294	9147.5	4.6445E-06	—	—	—	—
67770	0.2953	9199.2	6.9993E-06	103056	0.2977	9199.9	5.1126E-06	—	—	—	—
67974	0.2979	9200.2	7.0728E-06	103261	0.3009	9231.8	5.2683E-06	—	—	—	—
68178	0.3008	9305.8	7.2567E-06	103464	0.3036	9310.3	5.2268E-06	—	—	—	—
68382	0.3038	9346.2	7.4142E-06	103873	0.306	9333	5.0826E-06	—	—	—	—
68586	0.3068	9427.4	7.6375E-06	104076	0.3106	9388	4.7646E-06	—	—	—	—
68790	0.3098	9503.9	8.0712E-06	104484	0.3127	9463.6	4.3502E-06	—	—	—	—
68994	0.313	9538.7	8.4022E-06	104892	0.3159	9500.4	4.3175E-06	—	—	—	—
69199	0.316	9627.8	8.8679E-06	105299	0.3188	9620	4.5469E-06	—	—	—	—
69403	0.3197	9697.4	9.1979E-06	105503	0.3223	9639.9	4.5838E-06	—	—	—	—
69607	0.3239	9742	9.4434E-06	105912	0.3245	9746.7	4.8239E-06	—	—	—	—
69811	0.3272	9819.2	9.5343E-06	106320	0.3287	9807.9	4.8845E-06	—	—	—	—
70014	0.3315	9893.9	9.4537E-06	106728	0.3326	9908.5	4.8441E-06	—	—	—	—
70219	0.3352	9975.7	9.6884E-06	107136	0.3361	9955.3	4.9231E-06	—	—	—	—
70423	0.3391	10022.5	9.6309E-06	107339	0.3404	9953.8	4.8953E-06	—	—	—	—
70627	0.3432	10174.3	9.6182E-06	107748	0.3425	10026.4	4.9228E-06	—	—	—	—
70831	0.3467	10224.3	9.6918E-06	107952	0.3463	10103.9	4.9620E-06	—	—	—	—
71034	0.3513	10319.2	9.8988E-06	108360	0.3486	10156.5	5.2398E-06	—	—	—	—
71239	0.3549	10364	1.0120E-05	108564	0.3523	10189.6	5.4776E-06	—	—	—	—
71443	0.3586	10444.3	1.0176E-05	108972	0.3544	10302.7	6.0180E-06	—	—	—	—
71647	0.363	10577.1	1.0313E-05	109176	0.359	10340.4	6.1525E-06	—	—	—	—
71852	0.3676	10604.5	1.0484E-05	109380	0.3617	10383.9	6.3707E-06	—	—	—	—
72056	0.3717	10688.1	1.0399E-05	109584	0.3645	10508.6	6.6314E-06	—	—	—	—
72260	0.3759	10790.6	1.0517E-05	109788	0.3669	10548.5	6.7378E-06	—	—	—	—
72464	0.3798	10877.2	1.0784E-05	109992	0.3694	10626.4	6.9450E-06	—	—	—	—
72668	0.3846	11004.8	1.1126E-05	110197	0.3724	10651.7	7.1983E-06	—	—	—	—
72872	0.3886	11036	1.1450E-05	110400	0.3755	10705.2	7.2593E-06	—	—	—	—
73076	0.3935	11173.3	1.1651E-05	110605	0.3782	10735.7	7.3743E-06	—	—	—	—
73280	0.3981	11260.5	1.1791E-05	110809	0.3814	10784.1	7.6001E-06	—	—	—	—
73484	0.4031	11365.3	1.1420E-05	111013	0.3844	10881.4	7.9126E-06	—	—	—	—

Table D-1. DA/DN data for Al 7075-T6 in the center crack configuration with one specimen for each process (continued).

Process A			
Cycles	**Length (in)**	**Δ K (psi-in$^{1/2}$)**	**da/dN (in/Cyc)**
73688	0.4079	11494	1.1143E-05
73892	0.4129	11550.8	1.1015E-05
74095	0.4173	11594.2	1.0793E-05
74299	0.4209	11702.2	1.0742E-05
74503	0.4255	11788.9	1.0831E-05
74706	0.4306	11936.6	1.1180E-05
74910	0.4344	12002.3	1.1254E-05
75115	0.4391	12118.7	1.1497E-05
75319	0.4434	12246	1.1722E-05
75523	0.4487	12292.8	1.1868E-05

Process B			
Cycles	**Length (in)**	**Δ K (psi-in$^{1/2}$)**	**da/dN (in/Cyc)**
111217	0.3871	10912.8	8.0721E-06
111420	0.3907	10971.5	8.1496E-06
111625	0.3942	11040.3	8.3056E-06
111829	0.3977	11123.1	7.9715E-06
112033	0.4009	11181.8	7.6142E-06
112237	0.4039	11233.2	7.2364E-06
112441	0.4077	11320.9	6.8663E-06
112849	0.41	11416	6.2032E-06
113052	0.4153	11496.3	6.0385E-06
113256	0.4176	11525.9	5.9681E-06

Process C			
Cycles (in)	**Length (lb)**	**Δ K (psi-in$^{1/2}$)**	**da/dN (in/Cyc)**
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—

Table D-2. DA/DN data for Al 7075-T6 in the center crack configuration with one specimen for processes A, B, and C.

Process A				**Process B**				**Process C**			
Cycles	**Length (in)**	**Δ K (psi-in$^{1/2}$)**	**da/dN (in/Cyc)**	**Cycles**	**Length (in)**	**Δ K (psi-in$^{1/2}$)**	**da/dN (in/Cyc)**	**Cycles (in)**	**Length (lb)**	**Δ K (psi-in$^{1/2}$)**	**da/dN (in/Cyc)**
9420	0.0611	5444.4	8.50E-07	10851	0.0598	5370.6	6.76E-07	15997	0.0674	5722.7	7.89E-07
11865	0.0639	5648.3	1.28E-06	12075	0.0619	5462.8	8.31E-07	19097	0.0725	5921.2	8.74E-07
12680	0.0663	5740.5	1.38E-06	13910	0.0642	5591.2	9.16E-07	21560	0.0776	6086.9	9.52E-07
13293	0.0695	5837.1	1.27E-06	14726	0.0663	5664.9	9.30E-07	24261	0.0826	6302.3	1.05E-06
14722	0.0731	6019.3	1.38E-06	15949	0.0686	5771.9	9.88E-07	26646	0.0879	6486.9	1.13E-06
15538	0.0766	6098.9	1.19E-06	17581	0.0718	5911.3	1.16E-06	28870	0.0929	6660.7	1.22E-06
16966	0.0788	6189.7	9.89E-07	18600	0.074	5996.2	1.11E-06	30856	0.098	6834.4	1.31E-06
18393	0.0811	6280.6	1.01E-06	19416	0.0762	6065.2	1.14E-06	32762	0.1031	7007.5	1.39E-06
19210	0.0832	6348.5	9.98E-07	20028	0.0785	6135	1.25E-06	34432	0.1082	7166.4	1.44E-06
20230	0.0854	6442	1.04E-06	21660	0.0812	6283.3	1.29E-06	36180	0.1132	7336.3	1.49E-06
21455	0.0875	6540.6	1.11E-06	22476	0.0835	6358	1.38E-06	37848	0.1183	7492.3	1.55E-06
22680	0.0904	6633.9	1.18E-06	23497	0.0861	6468.7	1.30E-06	39596	0.1235	7665.2	1.59E-06
23701	0.0926	6715.7	1.14E-06	24109	0.0889	6548.1	1.42E-06	41106	0.1285	7824.3	1.62E-06
24517	0.0947	6813.7	1.16E-06	24924	0.0911	6652.8	1.37E-06	42536	0.1336	7957.1	1.66E-06
25333	0.0974	6844.1	1.31E-06	26351	0.0938	6756.3	1.43E-06	44284	0.1387	8139.7	1.72E-06
26760	0.0997	7000.5	1.72E-06	26963	0.0963	6805.1	1.56E-06	45794	0.1442	8293	1.74E-06
27577	0.1019	7096	2.33E-06	27780	0.0985	6900.4	1.48E-06	47222	0.1493	8424.5	1.74E-06
27984	0.1045	7148	1.95E-06	28391	0.1009	6986.9	1.60E-06	48653	0.1545	8589.7	1.78E-06
28392	0.1078	7239.3	2.15E-06	29004	0.1034	7046.8	1.54E-06	50242	0.1599	8746	1.82E-06
28800	0.1101	7285.4	2.13E-06	30228	0.1059	7170.3	1.45E-06	51830	0.1654	8899.2	1.91E-06
29820	0.1122	7404.8	1.44E-06	30839	0.1083	7211.8	1.53E-06	53022	0.1705	9017.6	1.99E-06
30636	0.1145	7462.3	1.26E-06	31656	0.1104	7340	1.73E-06	54374	0.1756	9178	2.15E-06
32063	0.1167	7562.9	1.34E-06	32268	0.1126	7374.1	1.67E-06	55565	0.1809	9312.9	2.30E-06
32675	0.1189	7633.4	1.34E-06	32676	0.1147	7426.3	1.66E-06	56837	0.1864	9491.9	2.43E-06
33287	0.1213	7666.7	1.34E-06	33288	0.1169	7489	1.68E-06	57790	0.1921	9611.8	2.54E-06
34103	0.1236	7728.1	1.49E-06	34308	0.1192	7608.4	1.58E-06	58744	0.1971	9753.2	2.62E-06
35122	0.1257	7830.5	1.51E-06	35124	0.1214	7669.4	1.72E-06	59776	0.2022	9898.6	2.71E-06
36141	0.1282	7931.5	1.67E-06	35735	0.1239	7745.5	1.72E-06	60730	0.2075	10026.1	2.80E-06
36752	0.1308	7988.4	1.76E-06	36364	0.1261	7810	1.63E-06	61764	0.2129	10177.2	2.90E-06
37568	0.1336	8103.9	1.91E-06	36773	0.1285	7866.3	1.66E-06	62638	0.2185	10309.8	3.07E-06
38181	0.1368	8187.6	1.91E-06	37588	0.1307	7941.9	1.47E-06	63511	0.2236	10452.9	3.22E-06
38792	0.1389	8240.5	1.87E-06	38812	0.1328	8045.9	1.44E-06	64385	0.2294	10599.7	3.41E-06

Table D-2. DA/DN data for Al 7075-T6 in the center crack configuration with one specimen for processes A, B, and C (continued).

Process A				**Process B**				**Process C**			
Cycles	**Length (in)**	**Δ K (psi-in$^{1/2}$)**	**da/dN (in/Cyc)**	**Cycles**	**Length (in)**	**Δ K (psi-in$^{1/2}$)**	**da/dN (in/Cyc)**	**Cycles (in.)**	**Length (lb.)**	**Δ K (psi-in$^{1/2}$)**	**da/dN (in/Cyc)**
39405	0.1413	8302.7	1.89E-06	39425	0.1349	8088.9	1.62E-06	65100	0.2346	10732.5	3.55E-06
40221	0.144	8399.4	1.99E-06	40037	0.1371	8124.9	1.78E-06	65895	0.2402	10874.2	3.71E-06
40832	0.1463	8460.4	2.13E-06	40648	0.1392	8225.8	1.83E-06	66530	0.2456	10995.4	3.89E-06
41445	0.149	8546.5	2.17E-06	41261	0.1414	8305	1.81E-06	67246	0.2506	11140	4.01E-06
41852	0.1516	8646.5	2.25E-06	41872	0.1443	8352.3	1.79E-06	67881	0.2561	11268.3	4.13E-06
42465	0.1537	8694	2.19E-06	42893	0.1467	8431.7	1.81E-06	68438	0.2613	11398.2	4.25E-06
43077	0.1568	8773.3	2.14E-06	43505	0.149	8520.2	1.97E-06	69074	0.2663	11555.2	4.43E-06
43689	0.159	8839.2	2.06E-06	44117	0.1517	8582	2.23E-06	69710	0.2715	11670.7	4.64E-06
44300	0.1617	8921.5	2.12E-06	44524	0.154	8656.8	2.36E-06	70266	0.277	11795.4	4.87E-06
44912	0.1639	9002.3	2.26E-06	45136	0.1561	8744.4	2.18E-06	70822	0.2824	11944.8	5.10E-06
45523	0.1666	9079.6	2.46E-06	45544	0.159	8808.2	2.18E-06	71299	0.2879	12087.2	5.18E-06
45930	0.1691	9141.6	2.61E-06	46156	0.1614	8867.2	1.92E-06	71775	0.293	12196.1	5.27E-06
46543	0.1717	9246.2	2.76E-06	47380	0.1643	8990.7	1.83E-06	72252	0.2982	12327.8	5.38E-06
46951	0.1746	9291.9	2.77E-06	47992	0.1665	9038.1	2.01E-06	72808	0.3033	12471	5.53E-06
47360	0.1773	9362.4	2.80E-06	48604	0.1693	9098.5	2.26E-06	73284	0.3087	12600.1	5.72E-06
47767	0.1796	9420.1	2.86E-06	49215	0.1719	9211.4	2.19E-06	73761	0.3142	12732.3	5.93E-06
48379	0.1818	9521.9	2.90E-06	49622	0.1749	9242.2	2.19E-06	74236	0.3199	12903.9	6.18E-06
48786	0.1849	9595.9	3.04E-06	50030	0.177	9311.9	2.17E-06	74634	0.3257	13009.8	6.41E-06
49194	0.1878	9644.5	3.16E-06	51049	0.1791	9437	2.14E-06	75111	0.3307	13172.4	6.71E-06
49602	0.19	9707.4	3.18E-06	51661	0.1821	9485	2.27E-06	75508	0.3366	13311.8	7.04E-06
50009	0.1926	9780.1	3.15E-06	52274	0.1852	9558.4	2.58E-06	75904	0.342	13455.9	7.53E-06
50417	0.1956	9896.4	3.13E-06	52886	0.1883	9634.7	2.88E-06	76302	0.348	13614.2	8.07E-06
50824	0.1982	9960.7	3.02E-06	53295	0.191	9712.7	3.02E-06	76620	0.3538	13760.1	8.33E-06
51232	0.2003	10032.4	2.86E-06	53703	0.1935	9771.7	2.84E-06	76938	0.359	13881.2	8.36E-06
51640	0.203	10079.2	2.85E-06	54111	0.1966	9853.1	2.89E-06	77256	0.3649	14045.4	8.56E-06
52049	0.2053	10125.7	2.87E-06	54520	0.1991	9925.8	2.67E-06	77574	0.3706	14187.2	8.65E-06
52661	0.2075	10229.9	3.05E-06	55336	0.2017	10015.9	2.41E-06	77972	0.3758	14366	8.85E-06
53069	0.2106	10277.5	3.31E-06	55744	0.2045	10069.8	2.47E-06	78289	0.3818	14498.3	9.28E-06
53478	0.2135	10377.3	3.58E-06	56356	0.2067	10164.7	2.76E-06	78608	0.388	14651	9.64E-06
53886	0.2158	10450.7	3.92E-06	56764	0.2096	10231.2	3.03E-06	78926	0.3941	14818.7	1.01E-05
54293	0.2193	10556	4.16E-06	57171	0.212	10305.3	3.14E-06	79165	0.4003	14951.3	1.06E-05
54701	0.2226	10597.9	4.45E-06	57580	0.2145	10340.4	3.23E-06	79482	0.4056	15154.3	1.14E-05
54906	0.2259	10706.1	4.46E-06	57988	0.2174	10427.2	3.04E-06	79721	0.4116	15291.4	1.19E-05
55314	0.228	10801.6	4.52E-06	58396	0.2204	10470.2	2.87E-06	79959	0.4171	15453.8	1.24E-05
55518	0.2316	10799	4.54E-06	58804	0.2227	10542.6	2.63E-06	80197	0.4236	15618.7	1.30E-05

Table D-2. DA/DN data for Al 7075-T6 in the center crack configuration with one specimen for processes A, B, and C (continued).

Process A				**Process B**				**Process C**			
Cycles	**Length (in)**	**Δ K (psi-in$^{1/2}$)**	**da/dN (in/Cyc)**	**Cycles**	**Length (in)**	**Δ K (psi-in$^{1/2}$)**	**da/dN (in/Cyc)**	**Cycles (in)**	**Length (lb)**	**Δ K (psi-in$^{1/2}$)**	**da/dN (in/Cyc)**
55926	0.2338	10934.5	4.40E-06	59620	0.2251	10633	2.54E-06	—	—	—	—
56334	0.2373	10999.9	4.32E-06	60027	0.2279	10729.5	2.72E-06	—	—	—	—
56741	0.2408	11115.3	4.28E-06	60640	0.2305	10808.3	3.03E-06	—	—	—	—
57150	0.2439	11222	4.36E-06	61047	0.2339	10868.6	3.35E-06	—	—	—	—
57558	0.2479	11323.6	4.48E-06	61455	0.2362	10934	3.53E-06	—	—	—	—
57966	0.2511	11363	4.69E-06	61862	0.2395	10983.8	3.60E-06	—	—	—	—
58170	0.2548	11410.8	4.63E-06	62271	0.242	11068.5	3.45E-06	—	—	—	—
58578	0.2569	11523.7	4.81E-06	62678	0.2457	11168	3.19E-06	—	—	—	—
58985	0.2607	11646.2	4.82E-06	63087	0.2487	11232.1	3.03E-06	—	—	—	—
59394	0.265	11794.2	4.84E-06	63698	0.2509	11338.5	2.99E-06	—	—	—	—
59598	0.2684	11838.4	4.80E-06	64106	0.2536	11349.7	3.24E-06	—	—	—	—
60006	0.2708	11932.2	4.96E-06	64514	0.2558	11438.2	3.75E-06	—	—	—	—
60210	0.2745	11957.8	5.12E-06	64921	0.2588	11513.5	4.27E-06	—	—	—	—
60618	0.2767	12077.7	5.64E-06	65329	0.2622	11627.1	4.67E-06	—	—	—	—
60822	0.2803	12104.6	5.81E-06	65533	0.2655	11710.3	4.86E-06	—	—	—	—
61025	0.2833	12203.6	6.10E-06	65940	0.268	11779.3	5.04E-06	—	—	—	—
61230	0.2854	12246.3	6.33E-06	66348	0.272	11923.6	5.10E-06	—	—	—	—
61434	0.2884	12365.7	6.30E-06	66552	0.2762	11962.6	4.74E-06	—	—	—	—
61638	0.2905	12393.8	6.48E-06	66959	0.2786	12062.3	4.43E-06	—	—	—	—
61842	0.2935	12470.2	6.49E-06	67163	0.2823	12102.1	4.23E-06	—	—	—	—
62046	0.2959	12535.7	6.65E-06	67774	0.2845	12221.6	4.06E-06	—	—	—	—
62251	0.2986	12593.6	6.65E-06	68182	0.2881	12318.4	4.25E-06	—	—	—	—
62455	0.3015	12694.2	6.87E-06	68590	0.2915	12386.5	4.66E-06	—	—	—	—
62659	0.3041	12747.3	6.95E-06	68998	0.2957	12469.6	5.14E-06	—	—	—	—
62863	0.3069	12810.9	7.19E-06	69202	0.2989	12536.7	5.12E-06	—	—	—	—
63067	0.3097	12892.7	7.40E-06	69406	0.3014	12607.9	5.22E-06	—	—	—	—
63271	0.3129	12967.5	7.50E-06	69610	0.3036	12668.6	5.52E-06	—	—	—	—
63475	0.3156	13069.8	7.59E-06	70018	0.3061	12781.9	5.49E-06	—	—	—	—
63679	0.3192	13154.4	7.52E-06	70222	0.31	12862	5.78E-06	—	—	—	—
63883	0.3221	13214	7.54E-06	70426	0.3125	12881.3	5.92E-06	—	—	—	—
64087	0.3251	13352.3	7.18E-06	70630	0.3148	12945.4	6.05E-06	—	—	—	—
64291	0.3283	13364.9	7.31E-06	70834	0.3171	13006.6	6.10E-06	—	—	—	—
64495	0.3311	13484	7.23E-06	71038	0.3201	13113.3	5.83E-06	—	—	—	—

Table D-2. DA/DN data for Al 7075-T6 in the center crack configuration with one specimen for processes A, B, and C (continued).

Process A				**Process B**				**Process C**			
Cycles	**Length (in)**	**Δ K (psi-in$^{1/2}$)**	**da/dN (in/Cyc)**	**Cycles**	**Length (in)**	**Δ K (psi-in$^{1/2}$)**	**da/dN (in/Cyc)**	**Cycles (in)**	**Length (lb)**	**Δ K (psi-in$^{1/2}$)**	**da/dN (in/Cyc)**
64699	0.3343	13555.6	7.26E-06	71243	0.3224	13125.7	5.69E-06	—	—	—	—
64903	0.3364	13588.2	7.37E-06	71447	0.3247	13203.2	5.43E-06	—	—	—	—
65310	0.3404	13765.2	7.87E-06	71855	0.3274	13314.3	5.61E-06	—	—	—	—
65514	0.3457	13864.4	8.45E-06	72059	0.3304	13357.1	5.83E-06	—	—	—	—
65718	0.3495	13913.9	8.35E-06	72264	0.3337	13409.7	6.15E-06	—	—	—	—
65922	0.3522	14060.4	8.71E-06	72468	0.3361	13493.9	6.45E-06	—	—	—	—
66126	0.3564	14166.5	8.91E-06	72672	0.3384	13589.2	6.22E-06	—	—	—	—
66329	0.3606	14171.5	9.15E-06	72876	0.3411	13668.9	6.35E-06	—	—	—	—
66533	0.3629	14374	9.13E-06	73080	0.3441	13740.8	6.45E-06	—	—	—	—
66737	0.3671	14455.7	9.20E-06	73283	0.3464	13796.2	6.42E-06	—	—	—	—
67145	0.3749	14658.2	9.70E-06	73692	0.3517	13922.9	7.09E-06	—	—	—	—
67349	0.3788	14705.6	9.65E-06	73896	0.3544	14010	7.40E-06	—	—	—	—
67553	0.3824	14801.1	9.82E-06	74100	0.3569	14088.6	7.81E-06	—	—	—	—
67758	0.3867	14941.1	9.82E-06	74303	0.3604	14149.2	8.42E-06	—	—	—	—
67961	0.3913	15095.8	9.96E-06	74507	0.3638	14322.8	8.84E-06	—	—	—	—
68165	0.3945	15198.2	9.95E-06	74711	0.3667	14366.4	9.23E-06	—	—	—	—
68369	0.3989	15322.9	1.04E-05	74915	0.3709	14510	9.43E-06	—		—	—
68573	0.4026	15465.3	1.11E-05	75118	0.375	14581.3	9.37E-06	—	—	—	—
68778	0.4072	15599.5	1.16E-05	75322	0.3784	14677.7	9.04E-06	—	—	—	—
68982	0.4113	15738.4	1.27E-05	75526	0.383	14763.1	8.77E-06	—	—	—	—
69186	0.4171	15814.8	1.37E-05	75934	0.3863	14993.9	8.93E-06	—	—	—	—
69389	0.4218	15997.9	1.45E-05	76138	0.3926	15091.4	9.25E-06	—	—	—	—
69593	0.4269	16206.4	1.52E-05	76341	0.3964	15186.6	9.80E-06	—	—	—	—
69798	0.4342	16351.2	1.64E-05	76545	0.3999	15302.2	1.04E-05	—	—	—	—
70002	0.4407	16561	1.72E-05	76750	0.4047	15405.9	1.11E-05	—	—	—	—
—	—	—	—	76954	0.4086	15589	1.15E-05	—	—	—	—
—	—	—	—	77158	0.4133	15689.4	1.19E-05	—	—	—	—
—	—	—	—	77362	0.4182	15817.1	1.26E-05	—	—	—	—
—	—	—	—	77566	0.4235	15951.9	1.33E-05	—	—	—	—
—	—	—	—	77770	0.4281	16088.8	1.39E-05	—	—	—	—
—	—	—	—	77974	0.4337	16279.2	1.49E-05	—	—	—	—
—	—	—	—	78178	0.4396	16509.1	1.61E-05	—	—	—	—
—	—	—	—	78382	0.4462	16681.8	1.69E-05	—	—	—	—
—	—	—	—	78586	0.452	16856.3	1.80E-05	—	—	—	—

Table D-2. DA/DN data for Al 7075-T6 in the center crack configuration with one specimen for processes A, B, and C (continued).

Process A			
Cycles	**Length (in)**	**Δ K (psi-in$^{1/2}$)**	**da/dN (in/Cyc)**
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—		—	—
—	—	—	—
—	—	—	—
—	—	—	—

Process B			
Cycles	**Length (in)**	**Δ K (psi-in$^{1/2}$)**	**da/dN (in/Cyc)**
78790	0.46	17123.2	1.88E-05
78993	0.4678	17334.3	1.95E-05
79197	0.4746	17572.9	1.98E-05
79401	0.484	17897.5	2.05E-05
79605	0.4916	18108.1	2.18E-05
79808	0.4997	18406.3	2.35E-05
80012	0.5083	18749.4	2.61E-05
80216	0.5181	19140.2	2.97E-05
80420	0.5292	19574.7	3.47E-05

Process C			
Cycles (in)	**Length (lb)**	**Δ K (psi-in$^{1/2}$)**	**da/dN (in/Cyc)**
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—

Appendix E. Statistical Analysis of Processes A, B, and C

Table E-1. Statistical analysis of processes A, B, and C for Al 2024-T3 in the center hole and center crack configuration using the student's T function.

Stress (ksi)	**Process Comparison**	**Mean (Log Cycles)**	**Std. Dev. (Log Cycles)**	**95% Confidence Level**				**Statistically Significant Difference**
				Log Max	**Log Min**	**Min Cycles**	**Max Cycles**	
Al 2024-T3 Center Hole Configuration								
13	Process A	5.328	0.761	5.241	5.416	174087	260475	neither process higher
—	Process B	5.297	0.0489	5.241	5.354	174259	225787	
10.5	Process A	5.606	0.122	5.446	5.746	292608	557011	Process B > process A
—	Process B	6.076	0.317	5.711	6.441	514473	2761794	
10.5	Process A	5.606	0.122	5.446	5.746	292608	557011	neither process higher
—	Process C	5.671	0.3064	5.319	6.0235	208424	1055594	
Al 2024-T3 Center Crack Configuration								
12.5	Process A	5.622	0.043	5.574	5.672	374506	469383	neither process higher
—	Process B	5.91	0.198	5.546	6.273	351889	1875300	
12.5	Process A	5.622	0.043	5.574	5.672	374506	469383	neither process higher
—	Process C	5.631	0.074	5.528	5.733	337426	540802	
11	Process A	6.029	0.339	5.709	6.349	511783	2234180	neither process higher
—	Process B	6.091	0.272	5.835	6.347	684419	2223017	
11	Process A	6.029	0.339	5.709	6.349	511783	2234180	neither process higher
—	Process C	6.198	0.28	5.683	6.713	482355	5163872	

Table E-2. Statistical analysis of processes A, B, and C for Al 7075-T6 in the center hole and center crack configuration using the student's T function.

Stress (ksi)	Process Comparison	Mean (Log Cycles)	Std. Dev. (Log Cycles)	95% Confidence Level				Statistically Significant Difference
				Log Max	Log Min	Min Cycles	Max Cycles	
Al 7075-T6 Center Hole Configuration								
12.5	Process A	5.053	0.038	5.01	5.097	102264	125075	Process B > process A
—	Process B	5.384	0.139	5.223	5.544	167274	349702	
12.5	Process A	5.053	0.038	5.01	5.097	102264	125075	Process C > process A
—	Process C	5.734	0.511	5.026	6.446	106315	2794598	
10	Process A	5.651	0.197	5.49	5.812	309174	648846	Process B > process A
—	Process B	6.213	0.401	5.752	6.674	565216	4723268	
10	Process A	5.651	0.197	5.49	5.812	309174	648846	Process C > process A
—	Process C	6.285	0.214	5.987	6.583	969748	3825705	
Al 7075-T6 Center Crack Configuration								
11	Process A	5.402	0.031	5.372	5.443	235581	271335	neither process higher
—	Process B	5.437	0.06	5.379	5.495	239284	312490	
10	Process A	5.672	0.407	5.204	6.14	159899	1380806	neither process higher
—	Process C	5.536	0.195	4.941	6.131	87377	1351183	

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